ABSTRACT

BREWER, J. R. Coronary heart disease risk factors in children ages 9 to 11 years. M.S. in Adult Fitness/Cardiac Rehabilitation, May 1991. 71 pp. (P. K. Wilson)

A total of 115 third through fifth grade students, ages 9-11 years, volunteered to participate in the coronary heart disease risk factor survey at Hintgen Elementary School in La Crosse, Wisconsin. The subjects were tested for the presence of the following: hypertension, obesity, physical inactivity, and family history of heart disease. Descriptive statistics and percentages were calculated to summarize the data. The results revealed that 13.9% of the subjects were hypertensive, 47.0% have body fat percentages which would be considered above the optimal range, 68.7% were less than physically active, 75.5% of the subjects have 2 or more risk factors, and 52.2% have a positive history of heart disease/attack.

CORONARY HEART DISEASE RISK FACTORS IN CHILDREN
AGES 9 TO 11 YEARS

A Thesis Presented
to
The Graduate Faculty
University of Wisconsin - La Crosse

In Partial Fulfillment
of the Requirements for the
Master of Science Degree

by
Julia R. Brewer
May 1991

UNIVERSITY OF WISCONSIN - LA CROSSE
College of Health, Physical Education and Recreation
La Crosse, Wisconsin 54601

Candidate: Julia R. Brewer

We recommend acceptance of this thesis in partial fulfillment of this
candidate's requirements for the degree:

Master of Science - Adult Fitness/Cardiac Rehabilitation

This candidate has completed her oral report.

[Signature]
Thesis Committee Chairperson

7/29/90
Date

[Signature]
Thesis Committee Member

7/29/90
Date

[Signature]
Thesis Committee Member

7-19-90
Date

This thesis is approved for the College of Health, Physical Education
and Recreation.

[Signature]
Dean, College of Health, Physical
Education and Recreation

2-13-91
Date

[Signature]
Dean of Graduate Studies

3-25-91
Date

ACKNOWLEDGEMENTS

In the pursuit of this degree I have many people to acknowledge and thank:

My committee members, Dr. Phil Wilson, Dr. John Porcari, and Dr. Larry Cozad for all their time, patience, and guidance.

My family, for their endless love and support in whatever I do.

Ken Murphy for his never ending support and friendship.

Lastly, I'd like to thank all of my class members for making this such a great year! I'll miss you guys!

Julia Brewer

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
Purpose of the Study	2
Statement of the Problem	2
Need for the Study	3
Null Hypothesis	4
Assumptions	4
Delimitations	4
Limitations	5
Definition of Terms	5
II. REVIEW OF RELATED LITERATURE	8
Introduction	8
Atherosclerosis	8
Heart Disease, Risk Factors, and Children	11
Hypertension	12
Hypertension and children	14
Cholesterol	15
Cholesterol and children	18
Obesity	20
Obesity and children	21
Physical Inactivity	23

CHAPTER	PAGE
Physical inactivity and children	24
Family History	25
Summary	26
III. METHODOLOGY	31
Introduction	31
Subject Selection	31
Instrumentation	32
Initial Procedures	33
Procedures	33
Testing Procedures	34
Parental Health History Questionnaire and Physical Activity Questionnaire	36
Statistical Treatment of the Data	37
IV. RESULTS AND DISCUSSION	38
Introduction	38
Subjects	38
Survey Results	39
Hypertension	39
Obesity	42
Obesity and Hypertension	42
Physical Inactivity	43
Family History	44
Multiple Risk Factors	45
Discussion	46

CHAPTER	PAGE
V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS	48
Summary	48
Conclusions	48
Null Hypothesis	49
Recommendations	49
REFERENCES CITED	50
APPENDICES	
A. Letter of Introduction	57
B. Parental Consent Form	59
C. Parental Health History Questionnaire	61
D. Physical Activity Questionnaire	63
E. Final Report to the Parents	65
F. Subject's Raw Data	69

LIST OF TABLES

TABLE	PAGE
1. Classification of Hypertension in Children as Proposed by the Second Task Force on Blood Pressure Control in Children	35
2. Classification of Percent Body Fat of Males and Females as Derived From the Sum of Tricep and Calf Skinfolde	36
3. Means and Standard Deviations of the Sample Population's Descriptive Characteristics	39
4. Means and Standard Deviations of Systolic Blood Pressure, Diastolic Blood Pressure, and the Sum of Tricep and Calf Skinfolde	40
5. Percentage of Subjects With Either Significant or Severe Hypertension	41
6. Percentage of Subjects Within Each Category of Percent Body Fat Classification	42
7. Percentage of Hypertensive Subjects That Were Also Overweight	43
8. Percentage of Subjects Within Each Physical Activity Assessment Category	44
9. Percentage of Subjects With a Positive Family History of Heart Disease, Hypertension, and High Cholesterol	45
10. Percentage of Subjects With Multiple Risk Factors	46

CHAPTER I

INTRODUCTION

Fifty-three percent of all deaths each year in the United States are caused by diseases of the heart and blood vessels. Coronary heart disease (CHD) accounts for approximately 800,000 or seventy-five percent of these deaths per year (Katch & McArdle, 1983).

Atherosclerotic CHD is among the most serious and costly health problems in all industrialized nations (Hurst, Schlant, Rackley, Sonnenblick, & Wenger, 1990). Its variability among nations, individuals, and social and ethnic groups is evidence that atherosclerosis is not an inevitable consequence of life (Cotran, Kumar, & Robbins, 1989). Hurst et al. (1990) state. "There is substantial and increasing evidence that atherosclerosis can be prevented" (p. 893).

Coronary heart disease is known to be precipitated by a number of different factors, including smoking, high cholesterol levels in the blood, high blood pressure, obesity, lack of exercise, and a familial propensity for heart disease (American College of Sports Medicine, 1986; Cotran et al., 1989; Hurst et al., 1990). Many investigators have reported the prevalence of these risk factors in children. For example, Wilmore and McNamara (1974) reported that forty-six percent of a sample of eight-to-twelve year old boys in California had one risk factor for coronary heart disease and an additional fourteen percent

had two or more risk factors. More recently, Harris (1987) found that sixty-two percent of the seven-to-twelve year old children in her study had one or more risk factor, while an additional twenty-one percent had three or more risk factors. Children with CHD risk factors need to be identified and monitored. These individuals should also be educated to develop lifestyle habits that can reduce the chance of developing heart disease later in life. Weinberg, Carbonari, and Laufman (1984) reported that in terms of primary prevention it may be what people do not know that places them at greatest risk. Berenson, McMahan, Voors, Webber, Srinivasan, Frank, Foster, and Blonde (1980) note, "If today's children grow up like their parents, twenty to thirty percent of them will have hypertension as adults, ninety percent will develop significant atherosclerotic lesions, and greater than fifty percent will die from hypertension and atherosclerotic lesions" (p.382).

Purpose of the Study

The purpose of the study was to survey third through fifth grade students from Hintgen Elementary School in La Crosse, Wisconsin for the presence of CHD risk factors.

Statement of the Problem

The problem of the study was to investigate the presence of CHD risk factors in third through fifth grade students at Hintgen Elementary School.

Need for the Study

Coronary heart disease is considered to be epidemic in the United States, accounting for approximately fifty percent of the deaths of middle-aged men (Falkner, 1980). Upon comparison, CHD accounts for more than four times as many lost years of life as do motor vehicle accidents (Berwick, Cretin, & Keeler, 1980).

Coronary heart disease is the narrowing of the coronary vessels, most often from atherosclerosis. This disease is widely acknowledged to be the result of many risk factors, especially hypertension, elevated serum cholesterol, obesity, and physical inactivity (Berenson et al., 1980; Cotran et al., 1989; Hurst et al., 1990; McCunney, 1987).

It is now clear from a variety of studies and from autopsy reports which examined coronary arteries from all ages that CHD exists early in life (Berenson et al., 1980; Cotran et al., 1989; Gilliam & MacConnie, 1984; Hurst et al., 1990; Voller & Strong, 1981). Indeed, risk factors such as hypertension, obesity, elevated blood lipids, and physical inactivity develop in some children as early as six years of age (Legwold, 1983; Williams, Arnold, & Wynder, 1977).

Coronary heart disease is an irreversible process. Increasingly successful treatment has improved the longevity of the lives of CHD patients, but the condition does not disappear (Gilliam & MacConnie, 1984; Rowland, 1981; Voller & Strong, 1981). It is therefore apparent that prevention is the cure.

Evidence suggests that identification and reduction of risk factors greatly decreases the chance of CHD later in life (Voller & Strong, 1981). As the majority of the risk factors for CHD are related

to lifestyles that are acquired early in life, it is logical that education and prevention should begin at this time (Voller & Strong, 1981). Because the family lives together, eats together, exercises together, and sometimes smokes together, primary prevention must also be family oriented (Williams et al., 1977). Therefore the focus of this study was to identify the presence of CHD risk factors in children enrolled in the third through fifth grades at Hintgen Elementary School in La Crosse, Wisconsin.

Null Hypothesis

The null hypothesis of this study was that third through fifth grade students at Hintgen Elementary School in La Crosse, Wisconsin do not display significant CHD risk factors.

Assumptions

The study was based on the assumption that third through fifth grade students located at Hintgen Elementary School in La Crosse, Wisconsin are representative of typical children enrolled in grades three through five.

Delimitations

This study was defined with the following delimitations:

1. This descriptive study was delimited to third through fifth grade students attending Hintgen Elementary School in La Crosse, Wisconsin.
2. The study includes only those subjects whose parents completed and returned a signed parental consent form.

Limitations

The following limitations were present in the study:

1. Subjects in the study participated on a voluntary basis.

Consequently, the sample does not represent true random sampling and may therefore lack external validity.

2. Subjects in the study were only nine to eleven years of age and their participation required parental involvement and cooperation. This may have created a source of sample bias. Parents participating in the study, along with their children, may have been more health conscious.

Definition of Terms

For the purpose of this investigation the following terms were defined:

Atherosclerosis - a long-term degenerative process in which the inner lining of the arteries become congested with lipid-filled plaques (Strong, 1978). In many instances this leads to occlusion of the artery, causing tissue death (Hurst et al., 1990).

Cardiovascular Disease - any one of numerous abnormal conditions characterized by the dysfunction of the heart and blood vessels (Glanze, 1986).

Cholesterol - one of a subgroup of steroids which is carried within lipoprotein in the blood and may be deposited in artery walls thereby facilitating the progression of heart disease (American Heart Association, 1983; Glanze, 1986).

Coronary Heart Disease (CHD) - narrowing of the coronary arteries leading to an imbalance of oxygen supply to oxygen demand with symptoms of chest pain (angina), and possible myocardial tissue necrosis and death (American Heart Association, 1985).

Coronary Heart Disease Risk Factors - measurable or observable factors with a known relationship to heart disease (Berenson, 1986; Kannel, 1975).

Elevated Plasma Cholesterol - (also called hypercholesterolemia) refers to greater than normal cholesterol levels in the blood (Glanze, 1986).

Fitness - a state of health characteristics, symptoms, and behaviors enabling a person to have the highest quality of life (Howley & Franks, 1986).

Hypertension - abnormal elevation of pressure within the arteries either during the contraction (systole) or relaxation (diastole) phases of the heart pumping cycle. Significant hypertension is a blood pressure measurement at or above 130/80 mmHg (National Heart, Lung, and Blood Institute's Second Task Force on Blood Pressure Control in Children, 1987). This is in accordance with guidelines established by the National Heart, Lung, and Blood Institute's Second Task Force on Blood Pressure Control in Children (1987).

Lack of Physical Exercise - when regular physical exercise is not performed for a duration of at least fifteen minutes, for a frequency of at least three times a week, and with an intensity of at least sixty-five percent of maximum performance (American College of Sports Medicine, 1986).

Lipoprotein - carriers of plasma lipids in the blood due to the blood insolubility of cholesterol. Two major types of lipoprotein are: low-density lipoprotein (LDL), which are the main carriers for cholesterol and are related to an increased risk for heart disease, and high-density lipoprotein (HDL), which are associated with a decreased risk for heart disease (American Heart Association, 1983; Cotran et al., 1989; Hurst et al., 1990).

Obesity - an abnormal increase in the proportion of fat cells, mainly in the subcutaneous tissues of the body (Glanze, 1986). Lohman (1987) states that for children (ages six to seventeen) a body fat percentage in the range of twenty to twenty-five percent and twenty-five to thirty percent for males and females, respectively, may be defined as moderately high. Values between twenty-five to thirty-one percent and thirty to thirty-five percent, for males and females, respectively, is classified as high.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Risk factor modification appears to play an important role in the prevention of cardiovascular disease. Over the past twenty to thirty years, outstanding epidemiologic studies such as those in Framingham, Massachusetts and Tecumseh, Michigan, have clearly shown the importance of relating risk factors to CHD (Berenson et al., 1980).

Because primary habit formation such as patterns of diet, smoking, and physical exercise are established in childhood and develop during youth, maximum benefit is likely to be achieved when intervention is initiated as early as possible in the evolution of the disease (Hetzel & Berenson, 1987). Therefore the purpose of this study was to attempt to identify the presence of CHD risk factors in children. Reviewed in this chapter will be the most recent literature available regarding atherosclerosis, CHD and its risk factors, and how these factors relate to children.

Atherosclerosis

Coronary heart disease involves a long-term degenerative process whereby the inner lining of the arteries become congested with lipid-filled plaques or fibrous tissues (Strong, 1978). This process, called atherosclerosis, begins in childhood and progresses silently for decades (Berenson, 1986). Although any artery may be affected, the

aorta and the coronary and cerebral systems are primary targets (Cotran et al., 1989).

Atherosclerosis is initiated early in life and evolves through various stages before becoming clinically apparent in middle and late adult years (Berenson et al., 1980; Cotran et al., 1989; Hurst et al., 1990; Voller & Strong, 1981). The lesions of atherosclerosis include the fatty streak and the fibrous plaque (Berenson, 1986; Hurst et al., 1990). Both of these appear on the innermost layer of the artery wall, the intima (Berenson, 1986). Flat, lipid-filled lesions called fatty streaks initiate the development of atherosclerosis in childhood (Berenson et al., 1980, 1986; Cotran et al., 1989; Hurst et al., 1990). These lesions are yellowish and cause little or no obstruction of the artery.

In 1963, the International Atherosclerosis Project examined the coronary arteries and aortas of 2300 subjects from fourteen different countries. Data from this project demonstrate the presence of fatty streaks in the aortas of some children less than three years of age and in all children greater than three years of age (McGill, Geer, & Strong, 1963). These streaks increase rapidly in the aorta between the ages of eight and eighteen (Berenson et al., 1980).

The presence of these streaks in the coronary arteries is delayed somewhat but were present in some individuals younger than ten years of age, with increasing numbers found in subjects older than ten years of age, and in all subjects older than twenty years of age (McGill et al., 1963). This is in agreement with the findings of Hurst et al. (1990) who report that fatty streaks appear in the coronary arteries at

approximately fifteen years of age and continue to increase in amount through the third decade of life. Falkner (1980) reported that approximately ten percent of autopsied subjects aged ten to fifteen years already had atherosclerotic lesions in the coronary intima.

These data, plus the data of Enos, Holmes, and Beyer (1953) and McNamara, Malot, Stremple, and Cutting (1971) who respectively noted that seventy-seven percent of Korean casualties and forty-six percent of the Vietnam casualties had atherosclerotic lesions with varying degrees of severity, provide evidence for the early beginnings of atherosclerosis.

In some, the lesions of the coronary vessels seem to undergo a transition into lumen-occupying fibrous plaques. These more advanced lesions begin to develop around the age of twenty-five (Berenson, 1986). The plaque is grossly white in appearance and becomes elevated so that it may protrude into the lumen of the artery. The development of the plaque is initiated by the generation of smooth muscle cells within the arterial intima. Subsequent accumulation of lipids causes these cells to form a fibrous cap which covers a deeper deposit of varying amounts of lipids and cellular debris. In some cases the plaque will enlarge sufficiently to occlude the lumen of the artery and compromise the blood flow to the involved tissue (Hurst et al., 1990). When this occurs in the coronary arteries it results in restriction of blood flow to the heart and can cause angina (chest pain) and even heart tissue death (American Heart Association, 1985).

It has been suggested that these fibrous plaques are derived from the fatty streaks found in childhood. The streaks are thought to

facilitate plaque growth by enhancing the process of cell generation and lipid accumulation (Hurst et al., 1990; Small, 1977; Voller & Strong, 1981). Small (1977) studied the cellular mechanism of lipid deposition in the atherosclerotic lesion and demonstrated an intermediate stage between the fatty streak and the plaque. Voller and Strong (1981) state that microscopic studies of the plaque demonstrate the same basic structure seen with the fatty streak, but there appears to be more connective tissue present in the plaque. Hurst et al. (1990) report that fatty streaks in children are often found in the same anatomical location as fibrous plaques in the coronary arteries of older individuals. Although this evidence lends significant support to the concept of progression from coronary fatty streak to fibrous plaque, the relationship has not been unequivocally proven (Hurst et al., 1990).

Heart Disease, Risk Factors, and Children

The development of CHD can be foreseen years before the first symptoms occur. Individual clinical, physiologic, biochemical, and behavioral parameters have been identified as predictors of cardiovascular morbidity and mortality. These are now referred to as cardiovascular risk factors (Berenson, 1986; Kannel, 1975). In general, the more risk factors present in a particular individual, the greater the chance of the individual developing CHD during his or her lifetime (Berenson, 1986; Cotran et al., 1989; Hurst et al., 1990; Katch & McArdle, 1983). The concept of clinical cardiovascular risk factors provided the stimulus to look for the origin of the disease and

its transition into adulthood (Berenson et al., 1980; National Heart, Lung, and Blood Institute's Task Force on Blood Pressure Control in Children, 1978).

The question of whether early childhood control of CHD risk factors will reduce the risk of fatal heart attacks or the incidence of heart disease in adult life has not been examined by longitudinal studies (Gilliam & MacConnie, 1984). However, since little doubt exists concerning the association of risk factors in adults and the incidence of CHD, the assumption that this would also be true of children is a logical one.

The American Heart Association (1985) reported the following as factors contributing to heart disease: hypertension, elevated serum cholesterol, obesity, lack of exercise, and a family history of heart disease. Each factor has some influence on the disease process and is interrelated with the others (Katch & McArdle, 1983). The following is a brief outline of these risk factors.

Hypertension

Elevated blood pressure accelerates the development of atherosclerotic plaques and increases the incidence of CHD (Berenson, 1986; Hetzel & Berenson, 1987; Hurst et al., 1990). The International Atherosclerosis Project documented a significant relationship between atherosclerosis and hypertension (McGill et al., 1963). Autopsy cases from this project demonstrated that raised atherosclerotic lesions present in the coronary arteries of known hypertensive individuals were greater in both number and severity when compared to those of

individuals of comparable age who were known to be normotensive. Kannel (1975) examined the effects of high blood pressure on the 5209 men and women involved for twenty years in the Framingham Heart Study. He states, "Of all the risk factors considered, hypertension emerges as the most common, most potent, and universal contributor to cardiovascular mortality" (Kannel, 1975, p.1). Thirty-seven percent of the men and fifty-one percent of the women who died from CHD had suffered from hypertension. Risk of death was found to increase in proportion to the elevation of blood pressure, systolic or diastolic, at any age, in either sex.

Some investigators believe that an elevated diastolic blood pressure may be more indicative of disease risk (Cotran et al., 1989; Hurst et al., 1990; Voller & Strong, 1981). The Inter-Society Commission for Heart Disease Resources showed an increased risk associated with elevation of diastolic blood pressure greater than 105 mmHg. The risk of a first major coronary event for this group was four times greater than those whose diastolic blood pressure was less than 85 mmHg (Voller & Strong, 1981).

The exact pathogenesis of the accelerated atherosclerosis seen with elevated blood pressure appears to be related to "the distending pressure of the blood within the vessels which exerts shearing force and damage to the intima" (Voller & Strong, 1981, p. 822). Experimental work suggests that increased pressure from the blood exerts a lateral force along the arterial wall and promotes the deposition of lipid within the intima (Small, 1977).

Hypertension and children. Although the prevalence of clinical hypertension is of a far lesser magnitude in children than in adults, there is ample evidence to support the concept that the roots of essential hypertension extend back into childhood (National Heart, Lung, and Blood Institute's Task Force on Blood Pressure Control in Children, 1978). Due to an increase in awareness of the problems related to hypertension and the availability of screening programs, more and more children are being found with elevated blood pressure (Harris, 1987).

When a child was diagnosed as hypertensive, the condition was often thought to be due to some underlying disease entity. However, research has shown that hypertension in children is neither rare nor always associated with other diseases (Harris, 1987). Indeed, upon examination of 360 children, twenty-eight percent were found to display blood pressures which would be classified as abnormally high (Binkhorst, Kemper, & Saris, 1980). More recently, the American Red Cross Oregon Trail Chapter in Portland, Oregon screened over 1500 eighth-through-twelfth grade students and found that seven percent had blood pressure readings above the norm for their age group (Harris & DelGrande, 1986). Lauer, Connor, Leaverton, Reiter, and Clarke (1975) reported data from the Muscatine (Iowa) Study in which nine percent of the children studied had systolic blood pressure greater than 140 mmHg and twelve percent had diastolic blood pressure greater than 90 mmHg. Nationally the incidence of pediatric hypertension varies from one to twenty-five percent (Harris, 1987).

Whether a hypertensive state in a child is a precursor to adult hypertension remains unclear (Harris, 1987). Londe (1966) classified children as hypertensive if their blood pressure level was above the 95th percentile after several routine determinations. He observed that the elevated pressure persisted for three to nine years in approximately sixty-five percent of the cases who had elevation above the 95th percentile. Hyeden, Bartel, McDonough, and Hames (1969) found that eleven percent of the 435 adolescents they studied were hypertensive (diastolic >90 mm Hg) on initial evaluation (single determination). Repeat evaluation seven years later on thirty of the 435 patients from the hypertensive group revealed eleven to have persistent high blood pressure, with six having some form of vascular complication in early adulthood, including two deaths. This indicates that not only do these children face an increased risk for CHD later in life, but they also suffer significant morbidity and mortality during their later childhood and adult years (Voller & Strong, 1981).

Cholesterol

Elevated serum cholesterol (hypercholesterolemia) is a major contributor to cardiovascular disease (Anderson, Castelli, & Levy, 1987; Berenson, 1986; Brown, 1989; Cotran et al., 1989; Hurst et al., 1990). The American Heart Association (1985) estimates that a man with a total blood cholesterol level greater than 250 mg/dl has approximately three times the risk of myocardial infarction as a man with cholesterol levels below 200 mg/dl. In a fourteen year follow-up of the Framingham Heart Study, Kannel, Castelli, Gordon, and McNamara

(1971) noted that the blood lipids were among the strongest factors associated with an increased incidence of CHD. In this study, men ranging from thirty to thirty-nine years of age whose plasma cholesterol level was 260 mg/dl had a three times greater incidence of CHD than a similar group with cholesterol levels less than 200 mg/dl. The Lipid Research Clinics Coronary Primary Prevention Trial reports that for every one percent reduction in elevated cholesterol level, there is a two percent reduction in CHD risk (Lipid Research Clinics Coronary Primary Prevention Trial Results II, 1984).

Cholesterol and lipids (fats) do not circulate freely within the blood, instead they are bound to a protein to form what is called a lipoprotein (American Heart Association, 1983; Glanze, 1986). Lipoproteins contain a combination of lipid, protein, and cholesterol. The two major carriers of cholesterol are low-density lipoprotein (LDL) and high-density lipoprotein (HDL). Low-density lipoprotein contains a high concentration of lipid and cholesterol and a relatively low concentration of protein. The reverse is true of HDL, which contains a high concentration of protein and a low concentration of lipid and cholesterol (Cotran et al., 1989; Glanze, 1986; Howley & Franks, 1986; Hurst et al., 1990; Voller & Strong, 1981).

Until recent years, only the total cholesterol level was considered in a CHD risk factor profile. The total cholesterol level, however, represents the cholesterol contained in both the LDL and HDL fractions (Hypercholesterolemia Handbook, 1989). Recent evidence suggests that the distribution of cholesterol among these various lipoproteins may be a more powerful predictor of heart disease than

simply the total blood cholesterol (Howley & Franks, 1986). Data from the Framingham Heart Study show a significant relationship between increased risk of CHD when either LDL cholesterol levels are elevated or when HDL cholesterol levels are low (Anderson et al., 1987). Consequently, the higher the total and LDL cholesterol levels, and the lower the HDL cholesterol level, the greater the risk of developing CHD.

The increased risk imparted by an elevated concentration of total cholesterol is prominently correlated to elevation of the LDL cholesterol level. The LDL cholesterol carry the greatest portion of serum cholesterol and, as they lead to an increased uptake of lipid in cells, are related to increased risk for heart disease (American Heart Association, 1983; Anderson et al., 1987; Cotran et al., 1989; Crouse, 1989; Hurst et al., 1990; Voller & Strong, 1981). The Lipid Research Primary Prevention Trial reported that the reduction of serum cholesterol levels in patients with high levels of LDL resulted in a reduced risk of myocardial infarction and death. The degree of reduction of serum cholesterol levels, principally through a decrease in LDL cholesterol concentration, was directly associated with the degree of reduction of risk (Lipid Research Clinics Coronary Primary Prevention Results II, 1984).

The HDL, as they remove lipid from the cells, are associated with a decreased risk of heart disease. Coronary heart disease risk and HDL cholesterol levels share a reciprocal relationship (Anderson et al., 1987; Cotran et al., 1989; Hurst et al., 1990). Risk of CHD is increased when HDL cholesterol levels are low, whereas the risk is

decreased when HDL cholesterol levels are high. Data from the Framingham Heart Study has shown that individuals with HDL cholesterol levels below thirty-five mg/dl are eight times more likely to suffer one of the complications of CHD than individuals whose HDL cholesterol levels are greater than or equal to sixty-five mg/dl (Anderson et al., 1987). Hurst et al. (1990) report that a decrease in HDL cholesterol concentration from sixty to thirty mg/dl is associated with twice the prevalence of CHD. The Framingham Study also found the ratio of total cholesterol to HDL cholesterol to be an excellent predictor of future CHD events. Coronary heart disease was observed more frequently among individuals with a total/HDL cholesterol ratio of 4.5 or more (Anderson et al., 1987).

Cholesterol and children. As many as one-third of all children over the age of twelve have elevated cholesterol levels. Williams et al. (1977) showed that forty-three percent of sixth-through-eighth grade students had cholesterol levels which would be classified as abnormally high. A study of 5000 children revealed that twenty-four percent had total cholesterol levels greater than 200 mg/dl, nine percent had values greater than 220 mg/dl, and one percent had levels greater than 240 mg/dl (Lauer et al., 1975). Berenson, Blonde, and Webber (1974) autopsied children who had died in accidents and discovered the presence of fatty streaks in the aortas and coronary arteries of thirty-five young people (average age, twenty). These fatty streaks were strongly related to the individual's levels of both total and LDL cholesterol.

Longitudinal studies in children have established that lipid and lipoprotein levels tend to persist with age (Lauer, Lee, & Clarke, 1988; Orchard, Donahue, Kuller, Hodge, & Drash, 1983). Lauer et al. (1988) found that cholesterol measurements obtained in childhood are predictive of adult levels of total and LDL cholesterol, with twenty-five to fifty percent of adult cholesterol variability explained by childhood levels.

The American Academy of Pediatrics and the American Heart Association recommend cholesterol screening of children from families who have members with known high blood cholesterol levels or who have had coronary disease in their early or middle years (American Academy of Pediatrics Committee on Nutrition, 1989). Because this inherited condition only comprises a small percentage of cases of elevated cholesterol, this strategy misses most of the children with elevated cholesterol levels (Brown, 1989; Voller & Strong, 1981). Dennison, Kikuchi, Srinivasan, Webber, and Berenson (1989) examined 3313 children (aged four to seventeen) and found that only forty percent of the children with elevated LDL cholesterol levels had a parental history of heart disease. Thus, by following the current guidelines, sixty percent of the children with high cholesterol values would have been missed. These authors state, "Although children with a family history of cardiovascular disease are at increased risk for lipid and lipoprotein extremes, not all children with extreme levels are identified by family history" (Dennison et al., 1989, p.193). Griffin, Christoffel, Binns, McGuire, and the Pediatric Practice Research Group (1988) reported similar findings. These researchers found that if

cholesterol screening were limited to those children with a parental or grandparental history of high serum cholesterol or early heart disease, an elevated LDL cholesterol level would only be identified in fifty-one percent of these children. Garcia and Moodie (1989) measured the blood cholesterol levels of 6500 children between the ages of three and eighteen years. Of 375 children found to have high LDL levels, forty-eight percent had no family history of heart disease or high cholesterol.

The appearance of a heart attack or sudden death in a parent in his or her fifties or sixties may be due to an inherited cholesterol problem of which the family had no knowledge. In this instance the surviving adult son or daughter may find that he or she has lived for twenty or thirty years with no knowledge of an inherited elevated cholesterol level that might have been corrected earlier (Brown, 1989). For this reason, many individuals feel that cholesterol screening should include all children, whether or not a parental history is indicated (Brown, 1989; Cooper, 1988; Dennison et al., 1989; Orchard et al., 1983; Voller & Strong, 1981). Cooper (1988) states, "...It is a good idea for every child to have a complete blood workup, including cholesterol and lipid studies, by the age of puberty. And certainly this should be done by the early to mid-teen years" (p.72).

Obesity

It is estimated that sixty to seventy million adults and ten to twelve million children are "too fat" by a total of 2.3 billion pounds (Katch & McArdle, 1983). After the twenty-four years of follow-up in

the Framingham Study, an important relationship was found between obesity and the incidence of coronary heart disease (Kannel et al., 1971). Dawber (1980) reports that a two- to four-fold increased risk of sudden death was discovered among men above their desirable body weight when compared with men at their correct weight.

Obesity is sometimes referred to as a "soft risk factor" as existing epidemiologic data indicate a weak association between obesity, per se, and heart disease risk (Hurst et al., 1990; Voller & Strong, 1981). Obesity has been associated with other risk factors such as hypertension, elevated serum cholesterol, and physical inactivity (Berenson, 1986). It is thought that the risk associated with obesity is largely attributable to the propensity of the obese individual to have these other risk factors (Berenson, 1986; Cotran et al., 1989; Hurst et al., 1990; Voller & Strong, 1981).

Obesity and children. Obesity acts as a significant independent risk factor for the development of hypertension (Aristimuno, Foster, Voors, Srinivasan, & Berenson, 1984; Voller & Strong, 1981). It adversely affects heart function by adding volume to an already elevated peripheral vascular resistance. This results in an increased workload on the left ventricle (National Heart, Lung, and Blood Institute's Second Task Force on Blood Pressure Control in Children, 1987). Studies of children with high blood pressure have shown that approximately fifty-five percent were also obese (Harris, 1987). Lauer et al. (1975) found that of the 2415 hypertensive school children they studied, twenty-three percent were obese (their relative weight was

obesity and hypertension lies in the fact that weight loss has been shown to result in blood pressure reduction.

Obesity and high relative weight apparently influence levels of serum lipid and lipoproteins in children (Lauer et al., 1975). Hurst et al. (1990) report that obesity accentuates atherosclerosis by predisposing an individual to hypercholesterolemia with elevated levels of LDL and decreased levels of HDL.

The outlook for the future is not bright. Gortmaker, Dietz, Sobol, and Wehler (1987) report that the prevalence of obesity and superobesity among children and adolescents has increased by between 17% and 306% over the last decade. Perhaps even more alarming is that there is suggestive evidence that obese children have a strong tendency to become obese adults (Charney, Goodman, McBride, Lyon, & Pratt, 1976; Lloyd, Wolf, & Whelen, 1961). For example, Aristimuno et al. (1984) reported the work of Abraham and Nordsieck who studied obesity in 120 adults that had been previously examined in childhood. The investigators found that eighty-six percent (forty-three out of fifty) of the overweight boys and eighty percent (forty out of fifty) of the overweight girls became overweight adults when they defined overweight as twenty percent or more above the average weight for a given sex, race, and height. Gortmaker et al. (1987) state that although adolescent obesity accounts for only thirty to forty percent of adult obesity, a majority of the heaviest adults were obese as adolescents. In addition, Charney et al. (1976) found that twelve percent of heavy babies (greater than the 90th percentile) were found to be "obese" (more than twenty percent above standard weight) in adult life and a

further twenty-two percent were "overweight" (ten to twenty percent above standard).

Physical Inactivity

Numerous studies of regular, vigorous physical activity have shown that such activity is accompanied by a decreased risk of fatal and nonfatal CHD. Dawber (1980), in summarizing the level of physical activity and its relationship to CHD in the Framingham Study, noted an increased risk among sedentary individuals, male or female. A three-fold increased risk was found among sedentary males compared with their most active counterparts. Among women, the risk for CHD was two and one-half times greater among sedentary individuals compared with those who were most active.

As with obesity, isolation of the mechanism of this effect and determination of its independence as a risk factor have yet to be achieved (Hypercholesterolemia Handbook, 1989; Rowland, 1981). While the existence of a direct effect of physical activity remains unclear, there is little doubt that regular exercise exerts a beneficial effect on the other major risk factors (Cotran et al., 1989; Hurst et al., 1990). Physical activity, or the lack thereof, appears to exert its influence on CHD risk through its effects upon the other major risk factors (Cotran et al., 1989; Hurst et al., 1990; Voller & Strong, 1981).

Differences between active and inactive people are not so apparent with regard to risk factors such as blood pressure and total cholesterol. The one exception appears to be HDL cholesterol and its

percentage of total cholesterol, both of which seem to increase in active adults (Montoye, 1985). The extent and type of exercise necessary for an increase in HDL cholesterol is not known (Rowland, 1981). Studies of men with coronary artery disease have indicated that even moderate exercise (walking or jogging 2.8 km, three times per week) will cause an increase in HDL cholesterol (Paul, 1969). Hartung, Foreyt, and Mitchell (1980) studied cholesterol levels in marathon runners, joggers, and inactive men and found a direct correlation between distance run and HDL cholesterol (sixty-five, fifty-eight, and forty-three mg/dl in the three groups, respectively).

Physical inactivity and children. It appears that physical activity causes similar results in children. In the study by Fisher and Brown (1982) thirty-eight seventh grade students were randomly assigned to an exercise, exercise and diet, diet only, or control group. The first two groups participated in thirty minutes per day, five days per week, of "vigorous" physical activity. After twelve weeks total cholesterol and body fatness decreased and work capacity increased in the first two groups. The "exercise only" group also increased in HDL and HDL/total cholesterol ratio. Similarly, Gilliam and Burke (1978) initiated a training program in fourteen girls, aged eight to ten. The subjects exercised for forty minutes per day, six days per week, for six weeks. There was no change in total cholesterol but HDL cholesterol and the ratio of HDL to total cholesterol increased significantly.

An increase in physical activity can cause a reduction in fatness, especially in obese children. Environmental factors such as overeating and physical inactivity have been identified as leading causes of childhood obesity (Gilliam & MacConnie, 1984). Several studies have indicated that obese children do not necessarily consume more food than their non-obese counterparts (Falkner, 1980; Gilliam & MacConnie, 1984). It therefore appears that decreased energy expenditure (physical inactivity) contributes more to the obese condition than does high food intake (Montoye, 1985).

Carey, Hager, and Harrison (1985) report that young people's performance levels on various tests of physical endurance have declined over the past decade, so that an average teenager would have difficulty keeping pace with a middle-aged jogger. Bradfield (1971) found that adolescent girls in the United States spent, on average, less than one hour per day in moderate or strenuous activity and that, of the remaining sixteen hours, nine were spent in light activity such as sitting. Carey et al. (1985) stated that the typical teenager spends an average of seven hours per day watching television. Gilliam and MacConnie (1984) report that in terms of duration and intensity, the activity patterns of children are not sufficient enough to promote cardiovascular health.

Family History

Existing evidence indicates that individuals with a positive family history of premature CHD (before the age of fifty) are at increased risk of developing the disease themselves (Voller & Strong, 1981). In

general, risk factors in children are higher if their parents' risk are also greater or if a parent died from CHD at a young age (Montoye, 1985). It is uncertain whether predisposition is genetic or the result of shared environmental factors (such as diet and activity patterns), acquired behaviors (such as smoking), or social habits (Ayman, 1934; Garn & Clark, 1976; Voller & Strong, 1981).

For example, hypertension is observed to be more frequent in the siblings of hypertensive individuals than in those of normotensive individuals (Voller & Strong, 1981). Ayman (1934) reported hypertension in twenty-eight percent of children with one hypertensive parent and in forty-one percent of children with two hypertensive parents. Similarly, the Ten State Nutritional Survey, which provided life cycle data on fatness trends from infancy onward, reported a strong "parent-child resemblance" with regard to obesity, suggesting both genetic and environmental influences (Garn & Clark, 1976).

Summary

Despite the onset of clinical evidence of coronary atherosclerosis in middle age or older, atherosclerosis begins in childhood (Berenson, 1986; Cotran et al., 1989; Hurst et al., 1990; Strong, 1978; Voller & Strong, 1981). Atherosclerosis occurs mainly in the aorta and in the cerebral and coronary systems (Cotran et al., 1989). This disease begins with a fatty streak and evolves into a fibrous plaque which may eventually occlude the vessel, leading to tissue death (Berenson et al., 1980, 1986; Cotran et al., 1989; Hurst et al., 1990). Many researchers have reported the presence of fatty streaks in the aortas

and coronary arteries of children between the ages of three and eighteen (Berenson et al., 1980; Falkner, 1980; Hurst et al., 1990; McGill et al., 1963). These streaks are felt to be the precursors of the fibrous plaques which appear later on in an individual's life (Hurst et al., 1990; Small, 1977; Voller & Strong, 1981).

The American Heart Association (1985) reported a variety of factors which are felt to be predictors of cardiovascular morbidity and mortality. These factors all have a known relationship to heart disease and are referred to as cardiovascular risk factors (Berenson, 1986; Kannel, 1975). These risk factors are: hypertension, elevated serum cholesterol, obesity, lack of exercise, and a family history of heart disease (American Heart Association, 1985). These risk factors are present in many of America's adult population. Perhaps more frightening, however, is the presence of these factors in children.

Hypertension, also called high blood pressure, accelerates the development of fibrous plaques in the arteries and increases the incidence of heart disease (Berenson et al., 1980; Hetzel & Berenson, 1987; Hurst et al., 1990). The exact reasons for this are unclear, but it may be that this increased pressure causes damage to the artery wall. Damage, in turn, facilitates the development of the fibrous plaque (Small, 1977; Voller & Strong, 1981). Some believe that essential hypertension has its roots in childhood (National Heart, Lung, and Blood Institute's Task Force on Blood Pressure Control in Children, 1978). Indeed, many studies have shown that hypertension in children is not a rare finding (Binkhorst et al., 1980; Harris, 1987; Harris & DelGrande, 1986; Lauer et al., 1975). There is also some

evidence that these elevated levels persist into adult life (Londe, 1966).

Serum cholesterol refers to the amount of cholesterol within the blood. As cholesterol is not soluble in the blood, it is carried by a protein to form what is called a lipoprotein (American Heart Association, 1983; Glanze, 1986). There are two major classes of lipoproteins: high-density lipoprotein (HDL) and low-density lipoprotein (LDL) (Cotran et al., 1989; Glanze, 1986; Howley & Franks, 1986; Hurst et al., 1990; Voller & Strong, 1981). Each of these lipoproteins has a different affect on heart disease risk. High levels of HDL are associated with decreased risk, whereas low levels of this lipoprotein are associated with increased risk (Anderson et al., 1987; Cotran et al., 1989; Hurst et al., 1990). This is because HDL removes lipid from the cells. Low-density lipoprotein, however, causes increased lipid uptake in the cells. Therefore, high levels of LDL carry increased risk, whereas low levels have decreased risk (American Heart Association, 1983; Anderson et al., 1987; Cotran et al., 1989; Crouse, 1989; Hurst et al., 1990; Voller & Strong, 1981). Many studies have reported elevated levels of cholesterol in children (Berenson et al., 1974; Lauer et al., 1975; Williams et al., 1977). The American Academy of Pediatrics and the American Heart Association recommend cholesterol screening only in those children with a known history of heart disease (American Academy of Pediatrics, Committee on Nutrition, 1989). These recommendations are now being contested by a variety of researchers (Brown, 1989; Dennison et al., 1989; Voller & Strong,

1981). These researchers recommend that cholesterol testing should be obtained on all children, regardless of their family history.

Obesity is a risk factor for heart disease because of the effects it has on the other risk factors. For this reason it is sometimes referred to as a "soft risk factor" (Hurst et al., 1990; Voller & Strong, 1981). Obesity has been associated with hypertension, high cholesterol values, and physical inactivity (Berenson, 1986). Evidence of these relationships has been found in both the adult and child population. In addition, obese children have a strong tendency to become obese adults (Charney et al., 1976; Lloyd et al., 1961).

Physical inactivity is also related to heart disease risk via its affect on the other risk factors. Physical activity has been shown to decrease obesity, increase HDL cholesterol, and decrease LDL cholesterol levels. This is true of the child (Falkner, 1980; Fisher & Brown, 1982; Gilliam & Burke, 1978) as well as the adult (Hartung et al., 1980). The lack of physical activity negates these beneficial effects.

It is well known that individuals with a family history of heart disease are at increased risk of having the disease themselves (Voller & Strong, 1981). Controversy exists as to whether this increased risk is due to a genetic predisposition or to an affect of environment (Ayman, 1934; Garn & Clark, 1976; Voller & Strong, 1981). Unfortunately, this is the one risk factor over which one has little or no control.

Childhood risk factors would not be of concern if the child outgrew those elevated levels (Gilliam & MacConnie, 1984). Several

investigators (Berenson et al., 1974, 1980) have examined the phenomenon of "tracking" in children. Tracking refers to the consistency of the risk factors over time (Montoye, 1985). Preliminary evidence shows that children with high levels of blood pressure, lipids, and percent body fat tend to retain those high levels and this could increase their adult risk (Gilliam & MacConnie, 1984).

Atherosclerosis is a culturally determined phenomenon, the product of our choices and behaviors. Many of the risk factors for coronary heart disease are controllable through behavior modification. However, adult habits are notoriously difficult to change, particularly those related to smoking, overeating, physical inactivity, and health maintenance (Seigel & Manfred, 1984). For this reason many of the risk factors of CHD are difficult or almost impossible to reduce. Rowland (1981) states, "... health issues of the past have been resolved through often dramatic advances in the technology of medicine, the challenge of conquering (heart) disease by altering human behavior is more problematic" (p. 5).

CHAPTER III

METHODOLOGY

Introduction

The purpose of this study was to survey the children enrolled in the third through fifth grades at Hintgen Elementary School in La Crosse, Wisconsin, for the presence of CHD risk factors. This chapter describes the subject selection, instrumentation, testing procedures, and statistical treatment of the data.

Subject Selection

The 208 third through fifth grade students enrolled at Hintgen Elementary School in La Crosse, Wisconsin were chosen as subjects. To remain in the study, the parents of subjects were required to complete and return the Parental Consent Form (Appendix B), the Parental Health History Questionnaire (Howley & Franks, 1986) (Appendix C), and the Physical Activity Questionnaire (Murphy, Alpert, Christman, & Willey, 1988) (Appendix D). Ninety-three of the subjects failed to comply with this first step and were therefore excluded from the study. The remaining 115 subjects underwent the following physical assessments: height/weight measurement, systolic and diastolic blood pressure readings, and measurements associated with percent body fat assessment. Students enrolled in grades three through five were chosen because it has been noted that these subjects are at an age in which

adult behaviors are being established and coronary heart disease risk factors have begun to be demonstrated (Weinberg et al., 1984).

Instrumentation

The following instrumentation was utilized in the implementation of this study:

1. Height and body weight measurements: The height and weight of each subject was measured using a standard medical scale with a rigid vertical height rod.

2. Systolic and diastolic blood pressure: A standard mercury sphygmomanometer was used to record blood pressure measurements.

3. Percent body fat estimation: A Lange Skinfold Caliper (Cambridge Scientific Industries, Inc., Cambridge, Maryland) was used to measure the tricep and medial calf skinfolds. These were taken according to the procedure developed by Lohman (1987). The sum of these measurements were then used to extrapolate for the estimation of percent body fat.

4. Parental Health History Questionnaire: A questionnaire detailing the health history of the parent's immediate family was completed by the parent (Appendix C). A modification of a health history questionnaire developed by Howley and Franks was utilized in this study (Howley & Franks, 1986).

5. Physical Activity Questionnaire: The survey method of Murphy et al. (1988) was utilized to estimate the subject's current activity level (Appendix D).

Initial Procedures

Testing was approved through the Research and Development Committee for the School District of La Crosse in March, 1990. Approval was also obtained from the Human Subject Research Committee of the University of Wisconsin-La Crosse. Parental approval was obtained via the Parental Consent Form (Appendix B) which was distributed to all third through fifth grade homeroom classes. This form was also accompanied by the Letter of Introduction (Appendix A). The required parental consent form was completed before a subject could be tested. A parent or guardian was also asked to complete and return both the Parental Health History Questionnaire (Howley & Franks, 1986) (Appendix C) and the Physical Activity Questionnaire (Murphy et al., 1988) (Appendix D).

Procedures

All testing was conducted at Hintgen Elementary School in La Crosse, Wisconsin. The testing was performed during school hours in the month of May, 1990. All subjects were scheduled at fifteen minute intervals. Upon entering the testing area the following measurements were taken in the following order:

- 1) systolic and diastolic blood pressure
- 2) height and weight measurements
- 3) skinfold assessment

Following completion of the testing period, each parent received a report of their child's results (Appendix E). Each report contained these values: the child's height, body weight, percent body fat

estimation, and blood pressure. The report also contained population norms for specific values as described in the literature.

Testing Procedures

The following is a descriptive account of how the measurements were attained.

Height and body weight measurements: As stated, the height and weight of each subject was measured using a standard medical scale with a rigid vertical height rod. Height was recorded to the nearest tenth of a centimeter, and weight to the nearest tenth of a kilogram.

Systolic and diastolic blood pressure: Systolic and diastolic blood pressure was measured using a mercury sphygmomanometer on the right arm. For each subject the first Korotkoff sound was recorded as the systolic pressure and the fourth sound was used for the diastolic pressure (Jureidini, Baghurst, Hogg, van Renen, Adams, Burnell, Goldblatt, & Vimpani, 1988). The appropriate sized cuff for an individual was determined in the following way: "The cuff should be long enough to completely encircle the circumference of the arm (with or without overlap) and wide enough to cover approximately seventy-five percent of the upper arm between the top of the shoulder and the olecranon" (National Heart, Lung, and Blood Institute's Second Task Force on Blood Pressure Control in Children, 1987, p. 3).

The Second Task Force on Blood Pressure Control in Children developed a classification of hypertension based upon their clinical experience and consensus (National Heart, Lung, and Blood Institute's Second Task Force on Blood Pressure Control in Children, 1987). Table

1 lists the classification of hypertension in children as proposed by this task force. This system was utilized to label hypertension in this study.

Table 1

Classification of Hypertension in Children as Proposed by the Second Task Force on Blood Pressure Control in Children

Age Group	Significant High Blood Pressure	Severe High Blood Pressure
6 to 9 years	Systolic BP ≥ 122	Systolic BP ≥ 130
	Diastolic BP ≥ 78	Diastolic BP ≥ 86
10 to 12 years	Systolic BP ≥ 126	Systolic BP ≥ 134
	Diastolic BP ≥ 82	Diastolic BP ≥ 90

Note. From "Report of the Second Task Force on Blood Pressure Control in Children-1987" by the National Heart, Lung, and Blood Institute's Second Task Force on Blood Pressure Control in Children, 1987, Pediatrics, 79, p. 7.

Body fat analysis: The procedure developed by Lohman (1987) was utilized in the determination of body fat percentage. The sum of a tricep and medial calf skinfold was used to extrapolate percent fat. The skinfold method has a three percent error in estimating percent fat and may be larger for individual children who have a unique distribution of fat (Lohman, 1987).

Tricep skinfold thickness was measured over the right triceps muscle at the midpoint between the acromion and the olecranon with a Lange skinfold caliper. The arm was flexed at a ninety degree angle to the forearm. A tape measure was used to determine the midpoint.

The medial calf skinfold was taken with the right leg placed on a bench with the knee flexed at ninety degrees. A vertical skinfold was taken at the level of the greatest calf girth. Measurements were taken three consecutive times, with the average taken as the final value. All measurements were taken to the nearest one millimeter.

Table 2 displays the classification of percent body fat, of both males and females, using the sum of the tricep and calf skinfold. This extrapolation was developed by Lohman (1987) and was used to classify each subject's percent body fat.

Table 2

Classification of Percent Body Fat of Males
and Females as Derived From the Sum of Tricep and Calf Skinfolts

Classification	<u>Range of the Sum of Tricep and Calf Skinfold</u>	
	Females	Males
Very Low	0 to 11	0 to 5
Low	12 to 16	6 to 10
Optimal Range	17 to 30	11 to 25
Moderately High	31 to 36	26 to 31
High	37 to 45	32 to 40
Very High	46 to 60	41 to 60

Note. From "The Use of Skinfold to Estimate Body Fatness on Children and Youth" by T.G. Lohman, 1987, Journal of Physical Education, Recreation, and Dance, 58, p. 100.

Parental Health History Questionnaire and Physical Activity

Questionnaire: Each subject received both the Parental Health History Questionnaire (Howley & Franks, 1986) (Appendix C) and the Physical Activity Questionnaire (Murphy et al., 1988) (Appendix D)

during homeroom class. These questionnaires were to be completed by the parent and returned during homeroom class time.

Statistical Treatment of the Data

Descriptive statistics were used to examine the data. Means and standard deviations were computed on the following characteristics: age, height, weight, systolic and diastolic blood pressures, and the sum of the tricep and calf skinfolds. These statistics were calculated for the entire group, and for each gender.

Percentages were used to examine and to make comparisons between the survey data. Once again these values were examined for each gender and for all subjects.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

The purpose of this study was to survey the presence of CHD risk factors in students enrolled in the third through fifth grades at Hingten Elementary School in La Crosse, Wisconsin. The risk factors surveyed were the following: hypertension, obesity, physical inactivity, and family history of heart disease. The following describes the physical characteristics and survey results of the sample population. The chapter also includes the statistical analysis of the data.

Subjects

The investigation included 115 subjects, ages nine to eleven years. Inclusion in the study required that the parents of the subjects complete and return the following three forms: the Parental Consent Form (Appendix B), the Parental Health History Questionnaire (Howley & Franks, 1986) (Appendix C), and the Physical Activity Questionnaire (Murphy et al., 1988) (Appendix D). In addition, each subject was required to undergo the following: height, weight, systolic blood pressure reading, diastolic blood pressure reading, and tricep and calf skinfold measurements.

The means and standard deviations of the descriptive characteristics of the males, females, and the entire group, are presented in Table 3. Individual data may be found in Appendix F.

Table 3

Means and Standard Deviations of the Sample Population's
Descriptive Characteristics

Variable	Mean	Standard Deviation
Age		
Males (N=57)	9.9	0.8
Females (N=58)	9.9	0.9
Entire Group (N=115)	9.9	0.8
Height		
Males (N=57)	142.7	6.6
Females (N=58)	139.1	20.9
Entire Group (N=115)	142.1	8.6
Weight		
Males (N=57)	38.9	9.3
Females (N=58)	35.9	7.1
Entire Group (N=115)	37.4	8.4

Survey Results

Table 4 displays the means and standard deviations for systolic blood pressure, diastolic blood pressure, and the sum of the tricep and calf skinfolds. Individual data may be found in Appendix F.

Hypertension

Elevated blood pressure is a known risk factor for CHD (Berenson, 1986; Hurst et al., 1990). In this study, hypertension was determined using the age group classification developed by the Second Task Force

on Blood Pressure Control in Children (National Heart, Lung, and Blood Institute's Second Task Force on Blood Pressure Control in Children, 1987). Table 5 displays the percentage of subjects that were classified as hypertensive according to these guidelines. Individual data may be found in Appendix F.

Table 4

Means and Standard Deviations of Systolic Blood Pressure, Diastolic Blood Pressure, and the Sum of Tricep and Calf Skinfolde

Variable	Mean	Standard Deviation
Systolic Blood Pressure (mmHg)		
Males (N=57)	107.5	10.1
Females (N=58)	103.7	11.8
Entire Group (N=115)	105.6	11.1
Diastolic Blood Pressure (mmHg)		
Males (N=57)	66.9	11.6
Females (N=58)	67.7	7.3
Entire Group (N=115)	67.3	9.6
Sum of Skinfolde (mm)		
Males (N=57)	28.9	9.7
Females (N=58)	29.1	9.8
Entire Group (N=115)	29.1	9.6

Table 5
Percentage of Subjects With
Either Significant or Severe Hypertension

	Hypertension	Hypertension	
	(Significant or Severe)	Significant	Severe
Males (N=57)	12.7%	7.5%	5.2%
Females (N=58)	5.3%	5.3%	0.0%
Entire Group (N=115)	13.9%	11.3%	2.6%

Nationally, the incidence of hypertension in children ranges from 1 to 25% (Harris, 1987). As Table 5 indicates, 13.9% of all of the subjects in this study have hypertension (11.3% of the subjects classified with significant hypertension and an additional 2.6% with severe hypertension). This percentage is almost double the findings of the American Red Cross Oregon Trail Chapter who found that 7% of their sample population had blood pressure levels above normal (Harris & DelGrande, 1986). The values in this study agree more closely with the findings of Lauer et al. (1975), who reported the results of the Muscatine (Iowa) Study in which 9% of the subjects had systolic blood pressure greater than 140 mmHg and 12% had diastolic blood pressure greater than 90 mmHg. Binkhorst et al. (1980), however, reported blood pressures which would be classified as abnormally high in 28% of the subjects they tested.

Obesity

The Framingham Heart Study demonstrated an important relationship between obesity and the incidence of CHD (Kannel et al., 1971). In the present study the procedure developed by Lohman (1987) was utilized to classify percent body fat into one of six categories: very low, low, optimal, moderately high, high, or very high. Table 6 shows the percentage of subjects within each category. The table also shows the percentage of subjects that were classified as "above the optimal range" i.e. moderately high, high, or very high. Individual data may be found in Appendix F.

Table 6
Percentage of Subjects Within Each Category
of Percent Body Fat Classification

Classification Category	Males (N=57)	Females (N=58)	Entire Group (N=115)
Very Low	0.0%	1.7%	0.9%
Low	0.0%	3.4%	1.7%
Optimal	42.1%	58.6%	50.4%
Moderately High	24.6%	15.5%	20.0%
High	19.3%	12.1%	15.7%
Very High	14.0%	8.6%	11.3%
Above Optimal	57.9%	38.2%	47.0%

Obesity and Hypertension

Obesity is a risk factor for CHD due to its association with other risk factors (Berenson, 1986; Cotran et al., 1989; Hurst et al., 1990;

Voller & Strong, 1981). Obesity acts as a significant independent risk factor for the development of hypertension (Aristimuno et al., 1984; Voller & Strong, 1981). Table 7 displays the percentage of hypertensive subjects that were also overweight. Individual data may be found in Appendix F.

Table 7

Percentage of Hypertensive Subjects That Were Also Overweight

Males (N=10)	Females (N=6)	Entire Group (N=16)
70.0%	66.7%	68.8%

As can be seen upon examination of Table 7, 68.8% (11 out of 16) of the hypertensive subjects in this study were also overweight (above the optimal range for his/her percent body fat). These results concur with those of Harris (1987) who reported that approximately 55% of her hypertensive subjects were also obese. The results of this study are, however, approximately three times greater than those of Lauer et al. (1975) who found that only 23% of their hypertensive subjects were obese.

Physical Inactivity

Numerous studies of regular, vigorous physical activity have shown that such activity is accompanied by a decreased risk of CHD (Dawber, 1980). Each subject's physical activity was designated into one of the following three categories: sedentary, slightly active, or active. The assessment was performed by the parent(s) using the questionnaire

designed by Murphy et al. (1988). Table 8 displays the percentage of subjects within each physical activity assessment category. The table also displays the percentage of subjects that were found to be "less than active" i.e. slightly active or sedentary. Individual data may be found in Appendix F.

Table 8
Percentage of Subjects Within Each Physical Activity
Assessment Category

Category	Males (N=57)	Females (N=58)	Entire Group (N=115)
Sedentary	3.5%	10.3%	7.0%
Slightly Active	50.9%	72.5%	61.7%
Active	45.6%	17.2%	31.3%
Less Than Active	54.4%	82.8%	68.7%

Family History

Existing evidence indicates that individuals with a positive family history of heart disease are at increased risk of developing the disease themselves (Voller & Strong, 1981). A questionnaire detailing the health history of the parents' immediate family was completed by the parent(s) of each subject (Howley & Franks, 1986). From this questionnaire the subject's family history of heart disease/attack, high blood pressure, and high cholesterol were determined. A subject's family history was considered positive if a parent, aunt, uncle, or grandparent displayed the trait. Table 9 shows the percentage of subjects with a positive family history of heart disease/attack,

hypertension, and high cholesterol. Individual data may be found in Appendix F.

Table 9

Percentage of Subjects With a Positive Family History of
Heart Disease, Hypertension, and High Cholesterol

Type of History	Males (N=57)	Females (N=58)	Entire Group (N=115)
Heart Disease/Attack	54.4%	50.0%	52.2%
High Blood Pressure	50.9%	56.9%	53.9%
High Cholesterol	40.4%	43.1%	41.7%

In general, risk factors in children are higher if the parents' risk is higher or if a parent died from heart disease (Montoye, 1985).

Voller and Strong (1981) report that hypertension is observed to be more frequent in the siblings of hypertensive individuals than in those of normotensive individuals. Data from this study support this claim. Of those subjects identified as hypertensive in this study, 75% reported having a history of high blood pressure. This trend was also present in other risk factors. For example, 48% of the subjects in this study were found to possess percent body fat values that are above the optimal range (see Table 5). Of these, 50% reported a family history of obesity.

Multiple Risk Factors

Many investigators have reported the presence of CHD risk factors in children (Berenson et al., 1980; Cotran et al., 1989; Harris, 1987; Wilmore & McNamara, 1974). In this study data were analyzed to

determine the percentage of subjects with one risk factor and the percentage of subjects with multiple risk factors. Table 10 displays the results of this analysis. Individual data may be found in Appendix F.

Table 10

Percentage of Subjects With Multiple Risk Factors

Number of Risk Factors	Males (N=57)	Females (N=58)	Entire Group (N=115)
One	42.1%	36.2%	39.1%
One or More	84.2%	67.2%	75.7%
Two or More	42.1%	31.0%	36.5%
Three or More	7.0%	8.6%	7.8%

The results of this study are different than those of other surveys. For example, Wilmore and McNamara (1974) found that 46% of their subjects had one risk factor and an additional 14% had two or more risk factors. The data from this study show a similar percentage of subjects with one risk factor, but the percentage of subjects with two or more risk factors is nearly three times greater. Harris (1987) reported the results of her study in which 62% of her subjects had one or more risk factor, while an additional 21% had three or more risk factors. Again, the results of this study do not agree with these findings.

Discussion

The purpose of this study was to survey the presence of CHD risk factors in students enrolled at Hintgen Elementary School in La Crosse,

Wisconsin. The investigation was performed on 115 males and females who provided parental consent. The subjects' ages ranged from 9 to 11 years.

Descriptive statistics were utilized to analyze the data. Means and standard deviations were calculated on the following: subjects' age, height, weight, systolic blood pressure, diastolic blood pressure, and the sum of tricep and calf skinfold. Percentages were also utilized to examine the results. All data was examined for the group as a whole and for each gender.

The results of this study indicate that children in the third through fifth grades at Hintgen Elementary School in La Crosse, Wisconsin display CHD risk factors. Hypertension was detected in 13.9% of the subjects. Approximately 48% of the subjects were found to display percent body fat values that are above the optimal range. Approximately 69% of the subjects were reported as being "less than active". Approximately 50% of the subjects were reported to have a family history of heart disease/attack. Another 50% reported a positive family history of hypertension, while approximately 40% reported a positive family history of high cholesterol.

Overall the results of this study agree with other studies which have been cited previously. The one instance where this was not true was in the survey of multiple risk factors. This study reported percentages which were much higher than those reported by other researchers (Wilmore & McNamara, 1974).

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to examine the presence of CHD risk factors in students enrolled in grades three through five at Hintgen Elementary School in La Crosse, Wisconsin. The investigation included 115 subjects, ages 9 to 11 years. Descriptive statistics and percentages were used to analyze the data.

Conclusions

Based on the results of this study the following conclusions were drawn.

1. Hypertension: Hypertension was present in 13.9% of the subjects. Although this finding is much larger than the findings of others (Harris et al., 1986), it agrees with the national incidence of hypertension in children which is 1 to 25%.
2. Obesity: Forty-seven percent of the subjects were classified as having body fat percentages above the optimal range. This high percentage supports the claim that obesity is quite prominent in our society (Gortmaker et al., 1987; Katch & McArdle, 1983).
3. Obesity and hypertension: Approximately 69% of the hypertensive subjects in this study were also overweight (above the optimal range). This value agreed closely with the finding of one investigator (Harris,

1987), while it was greater than the findings of other investigators (Lauer et al., 1975).

4. Physical inactivity: Approximately 69% of the subjects reported being "less than active" (sedentary or slightly active). This supports the belief that the children in today's society are physically inactive (Bradfield, 1971; Carey et al., 1985; Gilliam & MacConnie, 1984).

5. Family history: Fifty-two percent of the subjects reported a positive family history of heart disease.

6. Multiple risk factors: Approximately seventy-six percent of the subjects had one or more risk factors. Approximately thirty-seven percent of the subjects had two or more risk factors. Approximately eight percent of the subjects had three or more risk factors. These percentages agree closely with the findings of some studies (Harris, 1987) while they are almost double the findings of others (Wilmore & McNamara, 1974).

Null Hypothesis

Based on the survey results, the null hypothesis has been rejected.

Recommendations

The following recommendations are made for future studies:

1. It is recommended that follow-up testing be conducted on the same group of subjects to examine the phenomenon of tracking.
2. It is recommended that cholesterol testing be included in future studies.
3. It is recommended that different La Crosse area schools be used to examine the effects of economic status.

REFERENCES CITED

- American Academy of Pediatrics, Committee on Nutrition (1989). Indications for cholesterol testing in children. Pediatrics, 83, 141-142.
- American College of Sports Medicine (1986). Guidelines for exercise testing and prescription (3rd ed.). Philadelphia: Lea & Febiger.
- American Heart Association (1985). Heart facts. Dallas: Author.
- American Heart Association (1983). Eating for a healthy heart. Dallas: Author.
- Anderson, K., Castelli, W., & Levy, D. (1987). Cholesterol and mortality: 30 years of follow-up from the Framingham Study. Journal of the American Medical Association, 257, 2176-2180.
- Aristimuno, G., Foster, T., Voors, A., Srinivasan, S., & Berenson, G. (1984). Influence of persistent obesity in children on cardiovascular risk factors: the Bogalusa Heart Study. Circulation, 69, 895-904.
- Ayman, D. (1934). Heredity in essential hypertension: A clinical study of 1524 members of 277 families. Archives of Internal Medicine, 53, 792.
- Berenson, G. (1986). Causation of cardiovascular risk factors in children. New York: Raven Press.
- Berenson, G., McMahan, C., Voors, A., Webber, L., Srinivasan, S., Frank, G., Foster, T., & Blonde, C. (1980). Cardiovascular risk factors in children. The early natural history of atherosclerosis and essential hypertension. New York: Raven Press.
- Berenson, G., Blonde, C., & Webber, L. (1974). Cardiovascular profile of preschool children in a biracial community (Bogalusa, Louisiana): The Bogalusa heart study. New York: Raven Press.
- Berwick, D., Cretin, S., & Keeler, E. (1980). Cholesterol, children and heart disease. New York: Oxford University Press.
- Binkhorst, R., Kemper, H., & Saris, W. (Eds.). (1980). Children and exercise XI. Geneva, Switzerland: World Health Organization.
- Bradfield, R. (1971). Energy expenditure and heart rate of obese high school girls. American Journal of Clinical Nutrition, 24, 1482-1488.

- Brown, W. (1989). It's never too early to watch your child's cholesterol level. Newsweek, October 9, S-10.
- Carey, J., Hager, M., & Harrison, J. (1985). Failing in fitness: The health and exercise boom eludes America's kids. Newsweek, 105, 84-86.
- Charney, E., Goodman, H., McBride, M., Lyon, B., & Pratt, R. (1976). Childhood antecedents of adult obesity. New England Journal of Medicine, 295, 6-9.
- Cooper, K. (1988). Dr. Kenneth H. Cooper's preventive medicine program. Controlling cholesterol. New York: Bantam.
- Cotran, R., Kumar, V., & Robbins, S. (1989). Robbins pathologic basis of disease. Philadelphia: Saunders.
- Crouse, J. (1989). Gender, lipoproteins, diet, and cardiovascular risk. Lancet, 1(8633), 318-320.
- Dawber, T. (1980). The Framingham study: The epidemiology of atherosclerotic disease. Cambridge, MA: Harvard University Press.
- Dennison, B., Kikuchi, D., Srinivasan, S., Webber, L., & Berenson, G. (1989). Parental history of cardiovascular disease as an indication for screening for lipoprotein abnormalities in children. Journal of Pediatrics, 115, 186-194.
- Enos, M., Holmes, R., & Beyer, J. (1953). Coronary artery disease among U.S. soldiers killed in action in Korea. Journal of the American Medical Association, 152, 1090-1093.
- Falkner, F. (1980). Prevention in childhood of health problems in adult life. Geneva, Switzerland: World Health Organization.
- Fisher, H., & Brown, M. (1982). The effects of diet and exercise on selected CHD risk factors in children. Medicine and Science in Sports and Exercise, 14, 171. (Abstract).
- Garcia, R., & Moodie, D. (1989). Routine cholesterol surveillance in childhood. Pediatrics, 84, 751-755.
- Garn, S., & Clark, D. (1976). Trends in fatness and the origins of obesity: Ad hoc committee to review the ten state nutrition survey. Pediatrics, 57, 433.
- Gilliam, T., & Burke, M. (1978). Effects of exercise on serum lipids and lipoproteins in girls, ages 8-to-10 years. Artery, 4, 203-213.

- Gilliam, T., & MacConnie, S. (1984). Coronary heart disease risk in children and their physical activity patterns. In R. Boileau (Ed.), Advances in pediatric sport sciences (pp. 171-188). Champaign, IL: Human Kinetics.
- Glanze, W. (Ed.). (1986). Mosby's medical and nursing dictionary (2nd Ed.). St. Louis: Mosby.
- Gortmaker, S., Dietz, W., Sobol, A., & Wehler C. (1987). Increasing pediatric obesity in the United States. American Journal of the Diseases of Children, 141, 535-540.
- Griffin, T., Christoffel, K., Binns, H., McGuire, P., & the Pediatric Practice Research Group (1988). Family history as a screen for childhood hypercholesterolemia. Pediatric Research, 23, 291A.
- Harris, J. (1987). High blood pressure in children and adolescents. Health Education, 18, 31-33.
- Harris, J., & DelGrande, B. (1986). The need for hypertension prevention in school curriculum. The Oregon Journal of Health. Physical Education, Recreation and Dance, 47, 11-15.
- Hartung, G., Foreyt, J., & Mitchell, R. (1980). Relation of diet to high density lipoprotein cholesterol in middle-aged marathon runners, joggers, and inactive men. New England Journal of Medicine, 302, 357-363.
- Hetzel, B., & Berenson, G. (1987). Cardiovascular risk factors in childhood: Epidemiology and prevention. New York: Elsevier.
- Howley, E., & Franks, B. (1986). Health/fitness instructor's handbook. Champaign, IL: Human Kinetics.
- Hurst, J., Schlant, E., Rackley, C., Sonnenblick, E., & Wenger, N. (1990). The heart, arteries and veins. New York: McGraw-Hill.
- Hyeden, S., Bartel, A., McDonough, J., & Hames, C. (1969). Elevated blood pressure levels in adolescents in Evans County, Georgia: Seven year follow-up of 30 patients and 30 controls. Journal of the American Medical Association, 209, 1683.
- Hypercholesterolemia handbook. (1989). Pennsylvania: Merck Sharp & Dohme.
- Jureidini, K., Baghurst, P., Hogg, R., van Renen, M., Adams, P., Burnell, R., Goldblatt, E., & Vimpani, G. (1988). Blood pressure in school children measured under standardized conditions. The Medical Journal of Australia, 149, 132-134.

- Kannel, W. (1975). Role of blood pressure in cardiovascular disease: The Framingham Study. Angiology, 26, 1-14.
- Kannel, W., Castelli, W., Gordon, T., & McNamara, P. (1971). Serum cholesterol, lipoproteins, and the risk of coronary heart disease. Annals of Internal Medicine, 74, 1-12.
- Katch, F., & McArdle W. (1983). Nutrition, weight control, and exercise. Philadelphia: Lea & Febiger.
- Lauer, R., Connor, W., Leaverton, Reiter, M., & Clarke, W. (1975). Coronary heart disease risk factors in school children: The Muscatine study. Journal of Pediatrics, 86, 697-706.
- Lauer, R., Lee, J., & Clarke, W. (1988). Factors affecting the relationship between childhood and adult cholesterol levels: The Muscatine study. Pediatrics, 82, 309-318.
- Legwold, G. (1983). New verse, same chorus: Children aren't fit. The Physician and Sportsmedicine, 11, 153-155.
- Lipid Research Clinics Coronary Primary Prevention Trial Results II (1984). The relationship of reduction in incidence of coronary heart disease to cholesterol lowering. Journal of the American Medical Association, 251, 365-374.
- Lloyd, J., Wolf, O., & Whelen, W. (1961). Childhood obesity: A long-term study of height and weight. British Medical Journal, 2, 145-148.
- Lohman, T. (1987). The use of skinfold to estimate body fatness on children and youth. Journal of Physical Education, Recreation, and Dance, 58, 98-102.
- Londe, S. (1966). Blood pressure in children as determined under office conditions. Clinical Pediatrics, 5, 71.
- McCunney, R. (1987). Fitness, heart disease, and high-density lipoproteins: A look at the relationships. Physician and Sportsmedicine, 15, 67-77.
- McGill, H., Geer, J., & Strong, J. (1963). Natural history of human atherosclerotic lesions. In M. Sandler & G. Bourne (Eds.), Atherosclerosis and its origins (pp. 78-100). New York: Academic Press.
- McNamara, J., Malot, M., Stremple, J., & Cutting, R. (1971). Coronary artery disease in combat casualties in Viet Nam. Journal of the American Medical Association, 216, 1185-1187.

- Montoye, H. (1985). Risk indicators for cardiovascular disease in relation to physical activity in youth. In R. Binkhorst, H. Kemper, & W. Saris (Eds.), Children and exercise XI (pp. 3-25). New York: Oxford Press.
- Murphy, J., Alpert, B., Christman, J., & Willey, E. (1988). Physical fitness in children: A survey method based on parental report. American Journal of Public Health, 78, 708-710.
- National Heart, Lung, and Blood Institute's Task Force on Blood Pressure Control in Children (1978). Cardiovascular profile of 15000 children of school age in three communities, 1971-1975. DHEW Pub. # (NIH) 78-1472. Washington, DC: U.S. Government Printing Office.
- National Heart, Lung, and Blood Institute's Second Task Force on Blood Pressure Control in Children (1987). Report of the second task force on blood pressure control in children-1987. Pediatrics, 79, 1-25.
- Orchard, T., Donahue, R., Kuller, L., Hodge, P., & Drash, A. (1983). Cholesterol screening in childhood: Does it predict adult hypercholesterolemia? The Beaver County experience. The Journal of Pediatrics, 103, 687-691.
- Paul, O. (1969). Physical activity and coronary heart disease. American Journal of Cardiology, 23, 303.
- Rowland, T. (1981). Children, exercise and coronary heart disease. Current Problems in Pediatrics, 11, 5-54.
- Seigel, J., & Manfred, T. (1984). Effects of a ten-month fitness program on children. The Physician and Sportsmedicine, 12, 91-97.
- Small, D. (1977). Cellular mechanisms for lipid deposition in atherosclerosis. Journal of the American Medical Association, 297, I-873, II-924.
- Strong, W. (Ed.) (1978). Atherosclerosis: Its pediatric aspects. New York: Grune & Stratton.
- Voller, R., & Strong, W. (1981). Pediatric aspects of atherosclerosis. American Heart Journal, 101, 815-836.
- Weinberg, A., Carbonari, J., & Laufman, L. (1984). What high school students don't know about cardiovascular disease. Journal of School Health, 54, 112-117.
- Williams, C., Arnold, C., & Wynder, E. (1977). Primary prevention of chronic disease beginning in childhood. Preventive Medicine, 6, 344-357.

Wilmore, J., & McNamara, J. (1974). Prevalence of coronary heart disease risk factors in boys, 8 to 12 years of age. Journal of Pediatrics, 84, 527-533.

APPENDIX A

LETTER OF INTRODUCTION

Dear Parent/Guardian,

As partial fulfillment of my master's degree in the area of adult fitness and cardiac rehabilitation, I am conducting a survey of the presence of coronary heart disease risk factors in children enrolled in the third through fifth grades at Hintgen Elementary School. The survey is under the supervision of Dr. Philip K. Wilson. If you choose to allow your child to participate in the study, he/she will be examined for the presence of: 1) obesity, 2) high blood pressure, 3) physical inactivity, and 4) family history of heart disease.

All testing will be conducted during P.E. classes in the months of April and May, 1990. Each student will be scheduled for a fifteen minute period. During this time a variety of physical parameters will be measured on your child. Your child's height, weight and blood pressure will be recorded. In addition, his/her body composition will be estimated using a skinfold technique. Skinfolds are measured by grasping the layer of fat under the skin at several locations on the body. For this study, skinfold measures will be taken at two sites (arm and calf) to estimate the body composition of your child. Your child's family history and physical activity level will be obtained upon the completion of the Health History Questionnaire and the Physical Activity Questionnaire.

Upon completion of the study, each parent/guardian will be mailed a copy of his/her child's results. This will include a short explanation of the results as well as the norms associated with each measurement.

If you would like your child to participate I would greatly appreciate your completing and returning the attached questionnaires as well as the parental consent form with your child as soon as possible. (Don't forget to sign the consent form!) All data obtained will be kept confidential.

Please feel free to contact me at any time with any questions you may have. Thank you very much for your time and cooperation.

Respectfully yours,

Julia Brewer
Phone number: 788-7400

APPENDIX B
PARENTAL CONSENT FORM

PARENTAL CONSENT FORM

I, _____, the parent/guardian of _____, give permission for my son/daughter to participate in the coronary heart disease risk factor survey in conjunction with the University of Wisconsin-LaCrosse. I understand that participation in the study will involve one fifteen minute evaluation. I also understand that in the process of this evaluation my child will have the following physical parameters measured: height and body weight, blood pressure, and body composition determination via skinfold technique.

I understand that the information which is obtained will be treated as privileged and confidential and will not be released or revealed to any person without my expressed written consent. The information obtained, however, may be used for statistical or scientific purposes with my right of privacy retained.

Please indicate your choice:

_____ Yes, I would like my child to participate

_____ No, I would not like my child to participate

Parent's/Guardian's

Signature _____ Date _____, 1990

Please print _____
Name

The address I would like the final information sent to is:

(Street # and address)

(Town, State, Zip Code)

APPENDIX C

PARENTAL HEALTH HISTORY QUESTIONNAIRE

PARENTAL HEALTH HISTORY QUESTIONNAIRE

Subject's Name _____

Subject's Age _____

Has any BLOOD RELATIVE of either your spouse OR yourself had any of the following? Please check the appropriate response(s). Feel free to contact me with any questions you may have.

	Self/Spouse	Parent	Brother/ Sister
Diabetes	[]	[]	[]
Stroke	[]	[]	[]
Heart disease/heart attack .	[]	[]	[]
High blood pressure	[]	[]	[]
High cholesterol	[]	[]	[]
Cancer	[]	[]	[]
Obesity	[]	[]	[]

Reference: Howley, E., & Franks, B. (1986). Health/fitness instructor's handbook. Champaign, IL: Human Kinetics.

APPENDIX D

PHYSICAL ACTIVITY QUESTIONNAIRE

PHYSICAL ACTIVITY QUESTIONNAIRE

Dear Parent/Guardian,

How would you classify your child's current level of activity?

Please check one of the three following responses. Be sure to consider all of the choices before making your decision.

____ 1) Sedentary: gets very little exercise. For example: walks or runs less than 1/2 mile per day; spends most of his/her free time sitting, watching television, or reading.

____ 2) Slightly active: Gets some exercise. For example: walks or runs 1/2 to 1-1/2 miles per day; when not in school he/she spends more of his/her time in active play than he/she does in reading or watching television.

____ 3) Active: Is involved in programmed exercise two or three times per week. For example: YMCA soccer, basketball, softball, or walk/runs 1-1/2 miles or more per day.

Thank you for your time and cooperation.

Reference: Murphy, J., Alpert, B., Christman, J., & Willey, E. (1988). Physical fitness in children: A survey method based on parental report. American Journal of Public Health, 78, 708-710.

APPENDIX E

FINAL REPORT TO THE PARENTS

Dear Parent/Guardian,

Thank you for allowing your child to participate in the Coronary Heart Disease Risk Factor Study. As you may already know the following are factors that contribute to heart disease: smoking, high blood pressure, elevated blood cholesterol, physical inactivity, obesity, and a family history of heart disease. Evidence has shown that reduction of these risk factors early in life may help prevent the appearance of heart disease later in life. The majority of these risk factors are related to lifestyles that are acquired early in life, therefore it is logical that education and prevention should begin at this time. Because the family lives together, eats together, exercises together, and sometimes smokes together, prevention must also be family oriented. Help your child develop lifestyle habits that will reduce the chance of developing heart disease later in life. Encourage your child to exercise regularly and eat a healthy diet. Enclosed you will find a written report of your child's results. Reference standards for selected items are included to help you evaluate these results.

Subject Name _____
Height (centimeters) _____ Weight (kilograms) _____
Resting Blood Pressure (Systolic/Diastolic) _____
Sum of Tricep and Calf Skinfold _____
Physical Activity Assessment _____
Family History Assessment _____

REFERENCE STANDARDS FOR SELECTED TEST ITEMS

CLASSIFICATION OF BLOOD PRESSURE(BP) BY AGE GROUP

Age Group (years)	Significant High Blood Pressure (mmHg)	Severe High Blood Pressure (mmHg)
6 to 9	Systolic Greater Than 122 Diastolic Greater Than 78	Systolic Greater Than 130 Diastolic Greater Than 80
10 to 12	Systolic Greater Than 126 Diastolic Greater Than 82	Systolic Greater Than 134 Diastolic Greater Than 90

****Your child's blood pressure should not exceed that given for his/her age.**

BODY COMPOSITION

	Sum of Triceps and Calf Skinfolts (mm)
Boys, ages 6 to 13 years	10-25
Girls, ages 6 to 13 years	16-36

****The sum of triceps and calf skinfolts for your child should fall within the given range for the appropriate gender. A number below this range indicates a lower percent body fat, a number above this range represents a higher percent body fat.**

The following explanations may help you to better understand your child's results.

Resting Blood Pressure: Blood pressure is represented by two numbers. The first number is systolic blood pressure, or the pressure within the blood vessels while the heart is contracting. The second number is called diastolic blood pressure, and represents the pressure within the blood vessels while the heart is relaxed. These two numbers represent the amount of work the heart must do to pump blood to the body.

High blood pressure occurs when the blood vessels become narrowed and blood cannot easily pass through them. Research has shown that high blood pressure, also called hypertension, is a major risk factor for heart disease. A child who has persistently high blood pressure should be regularly checked by their physician. Common factors associated with high blood pressure are a family history of high blood pressure, obesity, lack of exercise, and a diet high in salt. Blood pressure may also become elevated when a person is nervous or excited. The finding of a single modestly elevated reading does not constitute high blood pressure but does indicate the need for further evaluation including repeated blood pressure measurements over time by your physician.

Body Composition: Body composition refers to the percentage of body weight which is made up of fat and that which is made up of lean body weight (muscle, bone, internal organs). The amount of body fat an individual has can be estimated using a skinfold technique. The skinfold technique involves grasping the layer of fat under the skin at several areas on the body. The back of both the arm and the leg were used in this study. A certain amount of fat is necessary for normal functioning of the body. However, excessive body fatness in adults has been associated with diabetes, high blood pressure, and heart disease. Studies suggest that those children who are over fat are more likely to be over fat as adults. Skinfold measures provide only an estimate of percent body fat, and the technique may result in considerable error for some individuals. If you feel that your child's score was high, a decrease in body fat can be safely achieved through a combination of a

sound eating plan and regular aerobic exercise such as walking, swimming, running or biking.

Physical Activity Assessment: Numerous studies of regular physical activity have shown that such activity is accompanied by a decreased risk of heart disease. Physical activity can cause a reduction in body fatness and hypertension. Exercise is as beneficial for the parent as it is for the child and it can be fun for the whole family. Encourage your child to be active and to adopt a healthy lifestyle at a young age.

Family History Assessment: An individual with a positive history of heart disease is a person who has a close blood relative (parent, sibling, aunt/uncle, or grandparent) that has had heart disease before the age of fifty. Existing evidence indicates that individuals with a positive family history of premature heart disease (before the age of fifty) are at increased risk of developing the disease themselves. In general, risk factors in children are higher if their parents' risk are also greater or if a parent died from heart disease at a young age.

A positive family history of heart disease is often felt to be the one risk factor over which we have no control. This, however, may not be true. It is unsure whether the increased risk is genetic (inherited) or a result of shared environmental factors (such as eating and physical activity patterns), or acquired behaviors (such as smoking). Therefore, practicing positive lifestyle habits (regular physical activity, low-fat diet, and abstinence from smoking) may reduce your child's "inherited" risk of heart disease.

Cholesterol: Another risk factor which must be considered is cholesterol. The American Heart Association and the American Academy of Pediatrics recommend cholesterol screening of children from families who have members with known high blood cholesterol or who have had heart disease in their early or middle years. Therefore, if your child comes from a family with either of these characteristics, it is recommended that you have his/her cholesterol levels checked.

Once again I'd like to thank you for your time and cooperation!

Sincerely,
Julia Brewer

APPENDIX F
SUBJECT'S RAW DATA

Subj. #	Sex	Age	Ht/Wt	SBP/DBP	Sum	Phy. Act.	MI	HBP	HCHOL	OBES
1	F	9	140.3/47.6	106/74	58	SA	+	+	+	-
2	M	9	135.9/33.8	98/68	27	SA	+	+	+	+
3	F	9	137.2/27.8	102/60	15	SA	+	+	+	-
4	F	10	145.4/42.9	134/66	23	SA	-	+	-	-
5	M	9	139.1/26.4	98/62	28	A	+	-	-	+
6	M	8	137.2/33.2	86/64	33	A	+	+	-	+
7	F	8	139.7/30.0	94/62	20	SA	-	-	-	-
8	F	9	129.5/34.3	102/72	34	SA	+	-	-	-
9	F	8	129.5/35.8	94/68	32	SA	-	+	+	+
10	M	9	132.1/27.8	114/62	20	A	-	-	-	-
11	F	9	140.9/34.8	84/54	30	SA	-	-	+	-
12	F	9	145.4/42.0	108/62	36	SA	+	+	+	-
13	M	9	137.8/34.1	102/66	27	SA	+	+	-	-
14	F	9	140.3/31.3	94/60	19	SA	+	-	+	+
15	F	9	127.0/26.8	92/64	18	SA	-	-	-	-
16	F	9	144.8/47.7	122/62	44	SA	+	-	+	+
17	M	9	141.6/32.5	128/52	18	SA	-	+	-	+
18	M	9	140.3/33.6	104/54	25	A	-	-	-	+
19	F	9	134.6/28.6	92/62	28	SA	-	-	+	+
20	F	9	130.2/27.7	106/72	31	SA	-	+	-	-
21	M	9	136.5/36.4	104/82	23	A	-	+	+	+
22	F	11	140.3/32.0	96/72	11	SA	-	-	-	-
23	F	11	137.8/33.4	102/62	38	A	+	+	-	+
24	F	11	158.8/42.6	124/76	25	A	+	-	-	-
25	M	11	130.8/27.0	98/68	19	A	+	+	+	+
26	F	11	143.5/47.3	104/66	50	SA	+	+	+	+
27	M	11	148.6/37.4	98/64	22	A	-	-	-	-
28	M	11	143.5/35.7	88/64	25	SA	-	-	-	-
29	F	11	137.2/28.4	92/62	18	SA	-	-	+	-
30	M	11	149.2/38.5	108/74	21	A	-	+	+	+
31	M	11	149.9/40.3	112/66	31	A	+	+	+	-
32	M	11	143.5/41.4	112/62	30	A	-	-	-	-
33	M	11	149.9/40.0	112/46	22	A	+	-	-	+
34	M	11	144.8/34.3	104/48	22	SA	-	-	-	-
35	M	11	152.4/61.5	126/84	41	SA	+	+	+	+
36	F	11	149.9/39.5	102/64	24	SA	+	+	+	-
37	F	9	192.4/26.6	110/76	27	SA	-	+	-	+
38	M	10	147.3/48.5	126/84	43	SA	-	-	-	+
39	M	10	144.8/36.3	104/48	26	S	-	+	-	+
40	F	10	147.3/35.2	112/70	24	SA	+	+	-	-
41	M	10	149.9/46.0	102/72	37	SA	+	+	+	-
42	F	10	140.3/31.8	98/66	29	SA	+	-	-	+
43	M	10	141.6/41.8	122/72	40	SA	+	-	+	+
44	M	10	147.3/41.6	104/72	39	A	+	+	+	-
45	M	10	140.9/37.3	116/82	38	SA	+	+	+	+
46	M	10	138.4/31.9	106/56	15	SA	+	+	-	-
47	M	10	142.2/37.9	112/82	32	A	-	-	-	-
48	F	10	141.6/42.9	92/76	43	S	+	+	-	-

Subj.#	Sex	Age	Ht/Wt	SBP/DBP	Sum	Phy.Act.	MI	HBP	HCHOL	OBES
49	M	10	147.9/40.9	96/42	32	SA	-	+	+	-
50	F	10	144.1/35.2	126/62	24	SA	+	+	+	+
51	F	10	135.9/32.7	106/72	21	SA	-	-	-	-
52	M	10	135.3/35.2	98/72	35	SA	+	-	+	-
53	F	10	137.2/31.1	108/66	25	SA	-	+	-	-
54	M	10	140.9/34.9	96/72	21	A	+	+	+	-
55	M	10	136.5/34.5	124/72	40	A	+	+	-	-
56	F	9	147.3/41.9	108/74	34	S	+	+	+	+
57	F	9	128.9/25.6	98/58	29	SA	-	+	-	+
58	M	9	133.4/41.4	108/56	46	A	-	-	-	-
59	M	11	140.9/33.2	94/40	14	A	+	-	-	-
60	F	11	153.0/46.4	118/66	27	SA	+	-	+	-
61	M	11	141.6/36.5	96/66	21	SA	+	-	-	-
62	F	10	144.1/46.4	114/76	39	A	+	+	+	+
63	F	10	142.9/40.0	116/82	39	SA	+	+	+	-
64	F	9	143.5/44.5	108/68	49	SA	+	+	+	+
65	M	9	140.3/36.7	114/72	30	SA	-	+	-	-
66	F	9	144.8/38.4	98/66	31	SA	-	+	+	+
67	M	10	142.2/33.9	98/68	24	A	-	+	-	-
68	M	11	140.3/26.1	108/76	19	A	+	-	-	+
69	F	10	159.4/44.5	100/70	18	SA	+	+	+	+
70	F	10	142.9/32.6	102/74	29	SA	-	-	+	-
71	M	10	141.6/51.7	118/78	51	S	-	+	-	+
72	F	11	151.8/54.5	138/74	47	S	-	-	-	-
73	M	10	140.9/42.2	104/60	30	SA	+	-	-	-
74	M	10	157.5/67.6	122/82	31	A	+	+	+	+
75	M	11	150.5/36.4	108/86	20	SA	+	+	+	-
76	F	11	146.1/41.8	102/76	29	SA	-	-	-	-
77	M	11	139.7/35.6	102/68	20	SA	-	+	-	-
78	M	9	138.4/33.9	106/62	22	SA	+	-	-	-
79	F	11	139.1/33.3	102/72	21	SA	-	+	+	+
80	M	11	163.2/59.2	124/72	40	SA	-	-	-	-
81	F	11	140.3/41.1	100/80	37	S	-	-	-	+
82	M	10	149.9/67.0	112/84	54	SA	+	+	+	+
83	F	9	138.4/34.1	94/64	31	A	-	+	-	+
84	F	10	147.9/43.8	86/72	30	S	+	+	-	+
85	M	10	144.8/35.2	114/72	19	A	+	+	-	-
86	F	11	132.1/27.6	88/70	21	S	-	-	-	-
87	F	10	141.6/33.8	98/62	24	SA	-	-	-	-
88	F	11	151.1/36.4	110/62	21	SA	+	+	+	-
89	F	11	134.6/25.5	92/72	25	SA	+	+	-	-
90	F	11	146.1/44.8	134/72	47	SA	-	+	-	-
91	F	11	144.1/38.5	92/48	26	A	-	+	-	-
92	M	10	142.2/43.4	102/82	46	SA	-	+	+	-
93	M	11	148.6/45.7	122/74	28	SA	-	-	-	-
94	F	10	148.6/45.3	110/78	34	SA	+	+	+	+
95	F	11	134.6/29.5	98/68	22	A	-	-	-	-
96	M	11	151.8/52.9	108/78	41	A	+	-	+	+

Subj.#	Sex	Age	Ht/Wt	SBP/DBP	Sum	Phy.Act.	MI	HBP	HCHOL	OBES
97	F	11	148.6/37.3	116/74	17	A	+	+	+	-
98	M	10	135.3/34.9	104/64	28	A	+	-	+	+
99	M	10	142.9/47.3	122/76	43	SA	-	-	-	-
100	M	9	133.4/26.8	108/58	12	A	+	-	+	-
101	F	9	127.0/24.1	92/48	13	SA	+	-	-	-
102	M	9	142.2/25.9	90/42	26	SA	+	-	-	-
103	M	9	132.1/31.5	102/52	25	SA	+	+	+	+
104	F	9	127.0/28.3	98/62	26	A	-	-	-	+
105	M	9	139.7/26.9	98/62	18	A	-	-	-	-
106	M	9	155.6/49.5	112/64	36	SA	-	-	-	-
107	M	9	142.2/37.9	118/72	31	SA	-	+	-	-
108	F	9	139.1/31.7	104/74	21	SA	-	+	-	-
109	F	9	132.1/30.9	92/72	32	A	-	-	-	-
110	M	9	133.4/28.9	102/64	23	A	+	+	+	+
111	M	9	144.1/40.3	114/74	30	SA	-	-	+	-
112	F	9	130.2/31.0	100/74	40	SA	+	+	-	-
113	F	8	133.9/29.7	102/72	27	A	+	-	-	-
114	F	9	133.4/30.9	98/62	29	SA	-	-	-	-
115	F	10	142.2/36.7	104/54	25	SA	+	+	+	-