School Health Scoliosis Referrals: A Descriptive Study of the Diagnosis, Treatment and Follow Up Rate of Scoliosis in Relation to Age, Sex and Ethnicity of Sixth Grade Students in the Rochester City School

Ann K. Reddington

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SCHOOL HEALTH SCOLIOSIS REFERRALS: A DESCRIPTIVE STUDY OF THE DIAGNOSIS, TREATMENT AND FOLLOW UP RATE OF SCOLIOSIS IN RELATION TO AGE, SEX AND ETHNICITY OF SIXTH GRADE STUDENTS IN THE ROCHESTER CITY SCHOOL DISTRICT

by

Ann K. Reddington

Submitted in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE IN EDUCATION

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1980
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ABSTRACT

This research was designed to assess the effectiveness of a school screening program for scoliosis among 294 sixth grade students in the Rochester City School District during the 1978-1979 school year. Data was collected regarding sex, ethnicity, age, follow up status, diagnosis, and treatment of the referred.

More females (172) were referred than males (122). Whites comprised half of the study (135), with Blacks (128) next, followed by Spanish (25), and Orientals (6), respectively.

Of the total number referred, only 143, or forty-eight and sixth tenths (48.6) percent, had follow up. This percentage of follow up is quite low, but other studies assessing the effectiveness of school health referrals report similar statistics. Only 52 of those seen by their health care provider actually were diagnosed as having scoliosis. The range of age was from nine to sixteen with forty-eight (48) percent, or 142 students, being 12-13 years old which is the average age of a sixth grader. The mean age was approximately the same in each follow up category and it was concluded that age was not an important variable in this study.

A chi-square test was applied to the interrelationship between the sex of the referred and their follow up care to
ascertain if one sex tended to seek evaluation more than the other. The hypothesis was rejected as there was a difference in the sexes, males having a greater follow up rate than females.

The correlation between the follow up status of the referred and ethnicity was accepted after a chi-square analysis revealed that one ethnic group did not tend to seek follow up care more than any other group. However, percentage distributions indicated a greater no follow up rate in the Black and Puerto Rican ethnic groups.

Over half of those seen by their health care provider had a normal diagnosis. The connection between the sex and diagnosis was questioned and statistically there was a relationship between sex of followed up students and diagnosis, females having scoliosis more often than males. Data collected regarding diagnosis of those followed up and their ethnicity demonstrated that ethnic groups did not tend to have one diagnosis more than the other.

There was no difference in the treatment of scoliosis between males and females. A Fisher-exact test was used to test the interrelationship between these two variables and the hypothesis was accepted. The last hypothesis inquired as to the connection between ethnic groups and treatment, and when a Fisher-exact test was applied to the data, ethnicity had nothing to do with the prescribed treatment.
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CHAPTER I

INTRODUCTION

Early screening and referral of scoliosis prevents severe deformity, results in a high quality of correction, and decreases morbidity associated with the more radical procedures required to correct neglected scoliosis.

Scoliosis is the third most expensive diagnosis following cystic fibrosis and spina bifida (Lowe, 1975). It is not a disease, but a descriptive term, and yet the most deforming orthopedic problem facing children. At the turn of the century, scoliosis was considered incurable and termed by many the "cancer of orthopedic surgery" (Risser, 1948). If left untreated, scoliosis may lead to serious complications in adulthood, such as interference with pulmonary and cardiac function, chronic back pain, decreased life span, and cosmetic implications leading to social maladjustment.

There is no cure or prevention for scoliosis. In eighty to eighty-five percent of the cases the term idiopathic scoliosis is employed as the causes are unknown. There is, however, increasing evidence of genetic or hereditary causative factors leading MacEwen to suggest that idiopathic scoliosis should be termed familial or genetic (1970).
An adolescent with scoliosis is not diagnosed, in most cases, without a screening program, since very few parents view their teenagers without clothing in those years of false modesty. The change in the spine is insidious and subtle, and many times it is virtually impossible for an inexperienced screener to detect a defect. At this age, children are seen only for emergencies by medical personnel who, under these conditions, do not usually initiate a scoliosis check. Finally, many people still excuse the manifestations of the symptoms during adolescent growth spurt as being synonymous with poor posture.

Effective February 1, 1979, Educational Law, Article 19, Section 905 (number 5) and the Regulations of the Commissioner of Education, Sections 136.1(h) and 136.3(15) requires all schools in New York State to provide scoliosis screening for each child between the ages of 11 and 16 at least once in each school year. Unfortunately, three major cities in New York State, Buffalo, Rochester and New York City, are exempt from this mandate. It is felt that the screening personnel are not available in these large city school districts and, therefore, scoliosis in this vulnerable age group progresses undetected in over a hundred schools in the state. The school is an ideal place to screen for possible defects, since all children in New York State between the ages of 6 to sixteen must attend either a public or private school. The Regulations of the Commissioner (number 5) further state school
authorities must advise parents or guardians by means in a written statement when a defect, disability or other condition is discovered.

Recently, such states as New Jersey, California, Hawaii, Florida, Washington, Maine, Delaware, Minnesota, Michigan, Wisconsin, and Massachusetts, have legislation, or have introduced bills mandating scoliosis screening in the schools (Backtalk, #4, 1979). Japan is the only country in the world that has mandated scoliosis screening for every school child (Backtalk, #6, 1979).

The American Academy of Orthopaedic Surgeons (July, 1974) gave its official recommendations on any program of routine examination of school children for the detection of scoliosis. The Academy recognized that by early detection more appropriate care and treatment of scoliosis is possible. The earlier a health problem is detected and resolved, the less negative effect there is apt to be on a child's bio-psycho-social development. As Wethers (1970) pointed out, a "full referral cycle" must be guaranteed, emphasizing the importance of ensuing care and treatment. Haggerty, et al. (1975) noted that the earlier the intervention, the more positive the effects from treatment on health, development and school attitudes. Tenske (1975) is even more definitive when he states that the purpose of a screening program is to identify potential risks before the defect or disease becomes disabling. A referral may be
initiated, but if follow up is lacking, such a referral is
of no benefit to the child.

Statement of the Problem

The study was undertaken to determine the degree of
success of a school health referral program among sixth
grade students for scoliosis, as measured by referral follow
up rate, diagnosis, and treatment. The relationship of age,
sex, and ethnicity was also investigated.

Hypotheses

The following hypotheses were tested:

\( H_0_1 \): There is no difference between males and females
regarding follow up, no follow up, and no
information.

\( H_0_2 \): Ethnic groups will not differ with respect to
follow up, no follow up, and no information.

\( H_0_3 \): Males will not differ from females in their
follow up diagnoses.

\( H_0_4 \): There is no difference in the diagnosis among
ethnic groups of those students followed up
for possible scoliosis.

\( H_0_5 \): There is no difference in the treatment of
scoliosis between males and females.

\( H_0_6 \): There is no difference in the treatment of
scoliosis among ethnic groups.
Definition of Terms

Scoliosis: One or more side to side curvatures of the spinal column, with rotation, caused by a lateral deviation of the vertebral column.

Adolescent idiopathic scoliosis: Condition without known cause diagnosed in children older than ten years.

Genetic or familial scoliosis: Scoliosis passed on to other family members through traits in the genes and chromosomes.

Lateral curve: The spinal column curves away from the midline of the body.

Midline of body: Longitudinal center of back.

Rotation: The spinal column has turned forcing the posterior ribs to protrude on one side of the back when the student is in a forward bending position.

Screening: Examination of the uncovered spine including the cervical, thoracic, lumbar, and thoracolumbar segments, viewing from the back, front, and sides.

Forward bending position: Bending forward at the waist with the knees straight, chin on chest, together and arms dangling to the floor facing an examiner, facing away from the examiner and facing to both sides.

Cervical segment of the spine: The upper seven vertebrae of the spinal column.

Lumbar segment of the spine: The five vertebrae between the thoracic segment of the spine and sacrum.
Thoracic segment of the spine: The twelve vertebrae between the cervical and lumbar segments of the spine upon which the ribs attach.

Scrreener: Community health nurse or certified physical education teacher who carries out the scoliosis screening in the Rochester City School District.

Referral: A written recommendation, by school health personnel, suggesting a child be seen by a health care provider for consultation, information, or decision making, regarding a single health problem.

Follow up: Completion, and return to the school nurse, of the written referral form by the health care provider indicating diagnosis and treatment.

No follow up: Failure to seek consultation with health care provider on part of family.

No information: Community Health Nurse unable to communicate with referred as to the assessment of follow up status.

Normal diagnosis: No findings of scoliosis; a normal spine.

Other diagnosis: A diagnosis other than scoliosis (frequently classed as kyphosis which is a rounding of the upper spine, lordosis which is the forward curvature of the lower spine, or unequal leg lengths).

Anterior approach to the spine: Entrance to the chest or abdomen through a longitudinal incision during corrective
surgery for scoliosis, which uncovers the bony elements of the front of the spinal column.

**Posterior approach to the spine:** Entrance to the back of the spinal column through a longitudinal incision during corrective surgery for scoliosis uncovering the back of the spinal column.

**Delimitations**

1. The findings of the study were limited to the collection of data on sixth grade students in the Rochester, New York, City School District, Monroe County, during the 1978-79 school year.

2. Parochial schools were not included in the original sample, but a few of the referred were located in parochial junior high schools.

3. The chronological ages of the sixth grader ranged from 9 years, two months, to sixteen years, one month.

4. Scoliosis screening was conducted by a trained physical education teacher, who in turn, referred any questionable cases of scoliosis to the Community Health Nurse in the school for a recheck and a referral, if indicated.

5. Screening was conducted during the student's regular physical education classes in the gymnasium offices, separating the sexes.
Significance of the Study

As a nurse-teacher it has been this investigator's experience that a large number of scoliosis referrals are ineffective in motivating parents to seek health care. Comparison of scoliosis screening studies is hindered by the fact that the mandate has been in effect a relatively short period of time. In the past, information on groups screened was absent, methods of screening were unclear, and the criteria for diagnosis was varied. A scoliosis screening program will be analyzed and recommendations for a more effective referral system should be helpful to school personnel responsible for screening.
CHAPTER II

REVIEW OF RELATED LITERATURE

The purpose of this chapter is to investigate previous research and related literature on the subject of scoliosis. The chapter is divided into three major sections: (1) the nature of scoliosis and the history of the condition itself, (2) the background of the school health referral program in general and specifically, the New York State scoliosis screening program, and (3) the past and current research in scoliosis in regard to the cause, incidence, and treatment of the condition.

Nature of Scoliosis

There are thirty-three vertebrae in the spinal column, all of which are superincumbent on each other, separated by intervertebral discs which act as shock absorbers. This entire system is supported on the sacrum by muscles and ligaments. Scoliosis is characterized by both a lateral curvature of the spinal column and a vertebral rotation where the rib cage takes on an ovoid shape. The disc spaces between each vertebra become unequal in height and thickness and the
vertebrae themselves become wedged and distorted.

All cases of scoliosis are either structural, which does not disappear when the observer manipulates the back of the observed, or postural (non-structural), where the curve disappears on side bending. Cases of scoliosis are also classified according to the etiology: (1) Idiopathic or genetic, (2) Congenital, and (3) Paralytic. Idiopathic scoliosis accounts for eighty-five (85) percent of all cases and is a condition occurring without known cause in adolescents. Congenital scoliosis is probably not of genetic origin, but instead is the result of some form of trauma to the zygote or embryo in the third to fifth embryologic week, according to Holt de Toledo (1979). The site of the vertebral anomalies is important in determining the patient's prognosis; the lower the curve, the more deforming the condition. Paralytic or neuromuscular scoliosis is caused by various disorders of differing etiologies such as poliomyelitis, cerebral palsy, or muscular dystrophy. The age of the patient at the time of onset also determines an additional classification: (1) Infantile, if it occurs from birth to three years of age, (2) Juvenile, if it occurs at age three through age ten, and (3) Adolescent, if it occurs from puberty to skeletal maturity.
History of Scoliosis

Moe, Winter, Bradford, and Lonstein (1978) reviewed the history of the condition of scoliosis in their book, *Scoliosis and Other Spinal Deformities*, and related that the word scoliosis is derived from the Greek word, Skoliosis, meaning crooked. As early as 500 B.C., Hippocrates, the Father of Medicine, treated abnormal spines, ignoring the popular opinion that the cause was attributed to evil spirits. Shortly after, Galen (131-201 A.D.) coined the words kyphosis, meaning rounding of the upper spine, and lordosis, denoting forward curvature of the lower spine. In 1579, Ambroise Pare stated that "poor posture was the probable cause of scoliosis," and straightened the spine with the application of an iron corset. However, once the corset was removed, the curvature returned. Andry coined the word orthopedia in 1741 and designed the guild sign of orthopedics, the Scoliotic tree (see Appendix I). This depicts the curved spine alongside a bent tree latched to a vertical pole by means of a rope. Postural habits continued to be considered the cause of scoliosis throughout the 19th century.

An important discovery in 1895 by Wilhelm Roentgen of Roentgen rays or X-rays would later prove indispensible in the treatment and assessment of scoliosis. Dr. Russell Hibbs performed the first successful spinal fusion for scoliosis.
in 1914; he approached the spine posteriorly and added autogenous bone-graft material, from the patient's own skeletal system, over the vertebrae. This material eventually coalesced preventing spinal mobility. Treatment up to this point consisted of Plaster of Paris casts and traction, but in 1946 Drs. Blount and Schmidt made the first crude distraction brace now perfected and known as the Milwaukee brace (Blount, 1958). This device resulted in a fifty percent reduction in surgery.

There were successful advances in surgical maneuvers developing following the forties. Both the anterior and posterior approach to the spine allowed for correction and fusion. In 1956 Dr. A. R. Hodgson performed the first spinal fusion anteriorly, exposing the spine from the front, rather than from the back. Spinal instrumentation, such as the Harrington rod, was devised to jerk the spinal column into place and insured correction while autogenous bone, from the patient's own skeletal system, was transplanted, providing fusion (see Appendix 2). In 1969 Dr. A. F. Dwyer in Australia carried out the first anterior disc excision combined with insertion of spinal screws and compression of the vertebral bodies with a fixed cable (see Appendix 3).

In 1966, a group of prominent orthopedic surgeons from all over the world, specializing in the treatment of scoliosis, met at the University of Minnesota and formed the Scoliosis Research Society having as their main goal the
reciprocal exchange of empirical knowledge.

History of School Health Programs and Referrals

The actual year the referral program through health screening was established is not documented. Early contributions to the school health movement came from Europe; the first organized, regular medical inspection system documented by physicians, dentists, and vision specialists was instituted in 1874 in Brussels, Belgium, according to Anderson (1976). Previous to 1850, the schools in the United States were dominated by the church and health education was not part of the curriculum. In 1850, the Report of the Sanitary Commission of Massachusetts was published directing attention to the importance of school health instruction and giving recognition to the school as an agency for the promotion of health. Boston was the first city to initiate health examinations in the schools in 1894. School nursing in the United States parallels the history of school health services in most instances. According to the guidelines for the American School Health Association (1974), it was the school nurse who implemented the services provided in schools.

In 1897, New York State instituted health services for school children. Children exhibiting symptoms of contagious diseases were screened by the health officer. According to
Brophy (1971), school health services during the period 1924-1949 were expanded to include additional screening, case-finding, and referral for diseases, surveillance of immunization levels, and first aid. This was a result of greater emphasis placed on the preventive component of the school health program. The main purpose then of screening was to identify health problems which were felt to reflect the health problems in the family, such as malnutrition, fatigue, and lack of personal hygiene, and, in addition, carry out health care services, which included referral and liaison with other school and community personnel.

Orthopedic screening of school children was started in 1950 in North America in Wilmington, Delaware, by Dr. Alfred Shands, Jr. and Dr. G. Dean MacEwen, and by 1963 the entire state was screening pupils, observing their gait as they walked, and viewing their backs in a forward bending position. The goal of the program was to discover scoliosis before it had progressed to such a degree that surgery was the only treatment alternative. At present, this objective in Delaware has been reached. West Virginia, Illinois, Pennsylvania, California, Minnesota, and Hawaii are states that have recently joined Delaware in screening school children for scoliosis without mandates.

Four states mandate school scoliosis screening. Specifically, every Board of Education in the State of New Jersey
must provide yearly scoliosis screening for all children between the ages of ten and eighteen, while in the State of Washington, screening is mandated for all children in grades five through eight (approximate ages of these students are ten to thirteen). It is felt that New Jersey screens the upper ages unnecessarily, while Washington overlooks the adolescent in the thirteen to fifteen year old age group who enters puberty later than his/her contemporaries. Massachusetts requires all children in public schools of the state be screened annually for scoliosis in grades five through nine, which like Washington, tends to bypass the cases of scoliosis that are manifested late in the ninth grade or during the tenth grade.

History of New York State School Screening Program

In New York State, the 1979 mandate came about due to a pilot screening program started by the Scoliosis Association, Inc. in the early 1970's. This pilot program triggered action by the New York State legislature mandating scoliosis screening programs in the schools for all children in the eleven to sixteen year old age group. Unfortunately, Rochester, Buffalo, and New York City are exempt from this mandate since legislators felt that these school systems were too large, lacking adequate personnel to implement the screening program.
Those responsible for the screening include the school physician, school nurse-teacher, school nurse, physical therapist (if one is employed) and physical education teacher. The Association, based in New York City, is a non-profit organization founded by patients and their families. One of its goals is education of the general public as to the importance of school screening. This is accomplished by the availability of an extensive audio-visual lending library, speakers, screening manuals, and quarterly newsletter, Backtalk. Locally, at the University of Rochester Medical Center, an organized program for the treatment of scoliosis began in 1939, under the leadership of Dr. Louis Goldstein, Professor of Orthopaedics. Under his direction, and following his recommendations, various school systems set up scoliosis screening programs before the mandate. Following the mandate, his office monitored the school screening program closely. He is responsible for setting up the reporting system now used in Western New York schools making possible the gathering of statistical information and reporting of the incidence of scoliosis in this area.
Past and Current Research

Genetic, Idiopathic, or Familial Studies

Genetic scoliosis is an inherited condition with possible sex linkage that is definitely familial. Keim writes that a sex-linked trait can only be transmitted from a carrier father to his daughter, while on the other hand, a carrier mother can transmit a sex-linked trait to either son or daughter (1978). The scoliosis trait may not pass on to every generation. However, if scoliosis manifests itself in every generation, it tends to be more severe in a parent and mild in a child, or vice versa. Mark Asher, et al., in their research (1975) agreed with Keim that idiopathic scoliosis appears to be a sex-linked, inherited defect, and stated that occurrence is in the eightieth percentile, while the remaining twenty percent represents sporadic cases.

A male child with normal parents who has a sibling affected with scoliosis has a two (2) percent chance of developing scoliosis himself. For a female child with the same set of circumstances, the risk is seven (7) percent. If, in addition, either parent has scoliosis, the risk to the male sibling is seven (7) percent and to the female sibling if forty-two (42) percent (Asher, et al., 1975). Keim (1978), on the other hand, states that if a person with scoliosis has
children, one third or thirty (30) percent of all offspring will have scoliosis; if both parents have scoliosis tendencies, even if one parent does not exhibit the symptoms of scoliosis, the odds that offspring will be affected are even greater—sixty (60) percent.

G. Dean MacEwen, M.D. (1974), in a study in Delaware, noted that fifteen (15) percent of his scoliosis patients had more than one member of the family affected by the condition. At the Alfred I. Dupont Institute in 1974, he followed one hundred consecutive patients and pointed out that forty-three (43) percent of the sisters and twenty-nine (29) percent of the brothers of these subjects had curves of at least ten degrees. Ruth Wynne-Davies (1968) studied first, second and third-degree relatives of one hundred and fourteen patients with scoliosis in Great Britain. Her findings suggested either dominant or multiple gene inheritance factors when she uncovered a strong family incidence with a higher occurrence in twins, families, and siblings than random distribution would support.

Incidence Studies

An article by Rogala, et al. (1978) credits Kane with the observation that the relationship between the prevalence of scoliosis and rigidity of criteria is inverse. That is, the more rigid and demanding the criteria for a diagnosis of
scoliosis to be made, the less commonly the diagnosis of scoliosis will appear. Conversely, the looser the criteria, the more common the diagnosis of scoliosis.

It is known that the earlier in life the curvature manifests itself, the more likely it is to have a significant increase later in life. According to Keim (1978), once the skeletal structure has completed the maturation process, approximately seventeen years and eight months in males and sixteen years and five months in females, there is generally no further danger from idiopathic scoliosis.

The quoted incidence of scoliosis by Kane and Moe (1970) was less than one (1) percent, while Brooks, et al. (1972) found that scoliosis occurred in over thirteen (13) percent of the subjects. This significant range indicates the importance of considering the population screened and the criteria applied before quoting the incidence. Recent school screening programs have shown the incidence of scoliosis to be much higher than previously believed. Approximately ten (10) percent of the school children between the ages ten and thirteen show some slight abnormality of the spine, but only one (1) to two and one half (2½) percent of that ten (10) percent will have a deformity significant enough to require treatment. Winter and Moe (1974) found a five degree curve or more in four (4) percent of those screened. A study by Beegel and Parisien (1973) found the incidence of scoliosis to be ten (10) percent.
Dr. Goldstein, in a personal interview (April, 1979), stated that two and one half people out of every one thousand in the United States have scoliosis, while one out of every ten in the ten to thirteen year old age group shows some abnormality of the spine. Brooks (1975) compiled figures from the scoliosis screening program in California in 1972 on twelve to sixteen year olds and listed the incidence of scoliosis increasing from eleven (11) to thirteen (13) percent in 1975.

For reasons unknown, scoliosis does not progress as quickly in boys as in girls. Cases requiring treatment are seven times more prevalent in girls than boys. Willner (1974) showed that adolescent girls with idiopathic scoliosis are actually taller, have significant height increase before their "growth spurt," and their growth spurt occurs earlier than their normal contemporaries. However, it is interesting to note that the onset of their menses is within the normal range.

School scoliosis screening in Minnesota in 1973-1974 covering eighty thousand students revealed nearly equal incidence based on sex: two and one half (2½) percent in boys and four and one half (4½) percent in girls. These statistics applied to the initial screening and did not follow up the progression of the condition. In Quebec, in 1976, there was equal sex incidence in smaller curves, but in larger curves there was a far greater incidence in females. Drs. Shands and Eisberg (1955) analyzed fifty thousand mini films made
during a survey for tuberculosis in Delaware in 1950 and found scoliosis in a ratio of three and one half (3½) of the females to only one (1) male. In 1976 a Chicago, Illinois high school population of eight hundred and sixty-one students were surveyed for scoliosis and the incidence of the condition was high, sixteen (16) percent. However, when the criteria for diagnosis was investigated, it was detected that a free x-ray was offered for all those exhibiting one or more of the symptoms of scoliosis, and thus small curves, even those that could not be detected without an x-ray (less than five degrees), were found and included in this sixteen (16) percent.

Smyrnis, et al. (1979) have made an interesting observation regarding school screening in Athens, Greece. Children with fair hair and blue eyes showed greater percentages of positive findings for scoliosis than children with dark complexions. Another interesting study done in 1955 by Segil reviewed both Caucasian and African students in Johannesburg, South Africa, and found scoliosis more prevalent in Whites than Blacks. This is the only known study comparing incidence in different racial groups.

**Treatment Studies**

Although the incidence of scoliosis ranges from less than one (1) percent to thirteen (13) percent, the incidence of
curves needing treatment is only three to six cases per thousand according to Lonstein (1977). Treatment depends on the patient's age, degree of curve, and the curve pattern. The degree of curve is measured directly from the x-ray by the Cobb method, so named for the physician who patented the instrument, J.R. Cobb (see Appendix 4). The upper and lower end vertebrae in the curve are identified and perpendiculars are drawn to their transverse axis. The angles at which these perpendiculars intersect determines the degree of curvature. In the cases where there is more than one curve, the major curve is the one with the greatest angulation and the other curves are classed secondary. The higher up in the spinal column the structural curve occurs, the less favorable the prognosis and the more extensive the treatment according to Risser (1976).

Once the degree of curve is known, one of three treatments is chosen depending on the amount of spinal deviation. The first, when the curve is less than twenty degrees, is observation and consists of semi or triannual visits to the physician's office for inspection of the back and comparison of x-rays. The second, for children under fifteen years of age (bone age) when the curve is twenty to fifty degrees, is exercise plus the Milwaukee brace. The exercise program strengthens muscles, increases the flexibility of the spine, and reshapes the rib cage. This kinetic program centers
around the pelvic tilt and the exercise regime demands the involvement and cooperation of the patient. It consists of ten to twenty minutes of rigorous exercise in and out of the brace twice daily. It must be emphasized, however, that exercise alone will never prevent progression of the curve, nor will it lessen the existing degree of curve. The Milwaukee brace is an apparatus that consists of steel bars, leather covered sponge pads, and a pelvic girdle. It extends from the chin strap and neck pads down to the wearers pelvis where lumbar pads rest on the hips (see Appendix 5). This brace effectively stretches the spine and corrects thoracic scoliosis in growing children without surgery. The principle of the brace is to reduce the unequal pressures on the growth center by three point pressure and employs the forces of distraction, lateral pressure, and rotation. It was the first treatment of scoliosis without plaster casts, even though the brace itself is made from a positive plaster mold. Once the brace is prescribed, the wearer is allowed out of the brace for only one hour a day, but may participate in most normal activities and all physical education classes except tumbling, body contact sports, or trampoline activities. It is to be worn from three to five years, until the patient completes the first year of college, or when the chronological age of eighteen is reached.

The third method of treatment is surgery. This is an area that has advanced significantly in recent years. When
necessary, the spine is stretched preoperatively by means of traction or casting. Traction is accomplished by immobilizing the body parts using either a frame or system of weights and counterweights. Casting is achieved by the application of Plaster of Paris to the realigned torso, choosing either the Cotrel, Turnbuckle, or Risser model. These preoperative measures attain accurate alignment for insertion of an internal straightening device in the spine during surgery.

Following preoperative stretching, the most common surgical procedure is the implantation of a Harrington rod and hooks that apply distraction or compression to the posterior spinal elements. Another surgical procedure is the Dwyer method which involves removal of discs and insertion of screws connected to a cable wire. The correction is completed and insured in both these instances by a spinal fusion. Here bone chips are taken from the patient's skeletal system and transplanted over the implanted internal fixation device and affected vertebrae to form a solid, nonflexible section of the spine.

Experiments in the area of innovative treatments are constantly being researched. Dr. John E. Hall (Lonstein, et al., 1976) from Boston's Children's Hospital introduced a brace less cumbersome than the Milwaukee brace, but can only be used for a specific group of flexible, low, lumbar curves. It uses the three point principle of distraction, lateral pressure,
and rotation, but lacks the neck ring and upright steel rods. It is called the Boston brace, orthoplast jacket, or TLSO (Thoraco-Lumbar-Sacral-Orthosis) and is fabricated from thermo-plastic which is resistant to heat (see Appendix 6). It can be ready the same day of fitting, whereas the Milwaukee brace takes six weeks from fitting to completion.

Dr. Barry R. Dworkin, a physiological psychologist at Rockefeller University in New York City, is researching treatment of scoliosis by biofeedback (Backtalk, April, 1980). He believes that patients can correct their curvature by a process of trial and error posture training. It is a technique in which the patient is made aware of changes in bodily functions and processes and is taught how to control them. Two nylon loops are connected to an electronic device worn over the chest area and when the posture deviates from the ideal, an audible signal is heard. When the posture is corrected, the tone will stop.

Dickson and Erwin (1978) report that for the past ten years Dr. Walter Bobechko, chief of orthopedic surgery at Toronto's Hospital for Sick Children, has been researching the treatment of scoliosis through implantation of an electro-spinal instrumentation device (E.S.I.) which stimulates the muscles on the convex side of the curve nightly to counteract progressive deformity. Platinum leads radiate from the E.S.I. and are attached to various portions of the spinal muscles.
A small radio receiver placed near the patient at bedtime sends an impulse into the patient every ten seconds throughout the night activating the receiver (E.S.I.) which stimulates the spinal muscles to produce gentle sensations of muscle contractions lasting one second. In the morning, the patient turns off the transmitter and is allowed full unrestricted activity with nothing showing externally. The receiver is removed when skeletal growth is completed, leaving the patient with a flexible, unfused, and relatively straight spine. The system has arrested progressive scoliosis in eighty-two (82) percent of cases and has corrected fifty (50) percent of this group (Backtalk, January, 1980).

In reviewing the condition of scoliosis, especially its past and present treatment, this investigator looks forward to the future when surgery will no longer be necessary to correct a badly deformed scoliotic spine. Severe curves will not exist. This will only become a reality if every child in the susceptible ages before and during puberty is screened annually in the schools, allowing conservative treatment in the form of observation, bracing, or perhaps one of the newer treatments such as E.S.I., thereby halting the progression of early curves.
CHAPTER III

PROCEDURES

This chapter includes demography of the community and population investigated, and the experimental procedures of the investigator.

Setting

Community

Rochester, an upstate New York city of approximately 296,200 people, has health services provided to both the public and parochial schools by the Monroe County Health Department in cooperation with the City School District. Eighty-five schools, public and parochial, composed of predominantly lower socio-economic Black and Puerto Rican families, are served by the county health department. A Community Health Nurse system comprised of thirty-five Community Health Nurses and twenty-nine Health Aides from the Monroe County Health Department provides special preventive health services to these schools. Rochester is one of the cities exempt from the mandate requiring scoliosis screening in the schools. However, due to the efforts of Dr. Louis Goldstein
of the University of Rochester Medical Center, and Dr. Robert Wood of the Monroe County Health Department, a school scoliosis screening program was inaugurated following the mandate to determine the incidence of scoliosis in sixth grade students in the Rochester City School District.

During the school year 1978 to 1979, there were 18,916 students in fifth through eleventh grades with 3,201 sixth graders in forty-one public schools. Three hundred and twenty-one of the sixth grade students were referred for possible spinal deviation. Since twenty-seven of these could not be located, two hundred and ninety-four (294) comprised the sample for this study.

Population

Every sixth grader in a public school in the Rochester City School District was screened for scoliosis in the 1978-1979 school year. Although the student population is representative of a large urban school district, there is no breakdown available from the district offices as to the sex or ethnic background of the students. However, it is realized that the ethnic composition includes a large proportion of Blacks and Hispanics. The elementary schools are characteristic of neighborhood schools because the student population comes from the geographical area surrounding the schools.
All students between kindergarten and sixth grade attend neighborhood schools with the exception of the special schools for emotionally and physically handicapped and the learning disabled which draw their enrollment from other areas of the city. The student population of the high schools on the other hand represents a larger geographical area since there are no boundaries limiting attendance.

Background Information

Reports returned following a workshop held March 22, 1979 at the University of Rochester by Dr. Louis A. Goldstein, revealed the incidence of scoliosis in Monroe and eight surrounding counties (see Appendix 7). This researcher found that the data gathered represented too large a geographical area and the information compiled was insufficient for determining the occurrence of scoliosis in a particular vicinity. The only school district that had one hundred (100) percent of any one grade was the Rochester City School District. Therefore, this was the sample selected by this investigator. However, the form developed by Dr. Goldstein (see Appendix 8) did not lend itself to specifically identifying the variables of interest to this author. As a consequence, a new instrument (see Appendix 9) was designed by the author and later approved and endorsed by Dr. Goldstein and the Director of
Nurses in the Community Health Department of the School Health Program (see Appendix 10). This redesigned form requested additional information other than sex, diagnosis, and treatment not included on the original form, namely, follow up status, age at the time of referral, and ethnicity.

The new form was distributed to the Community Health Nurse in each of the forty-one schools for their use in October, 1979, along with a cover letter describing the purpose of the study and requesting their participation (see Appendix 11). Accompanying the new form was a copy of the nurse's original summary sheet collected by Dr. Goldstein's office for reference and comparison purposes. The revised summary sheets based on the completed referral forms were returned to the Director of Nurses by the school nurses, who in turn sent them to this investigator. Those elementary school nurses who failed to return the data were personally contacted by telephone, which often prompted completion of their follow up.

Many times the follow up of a sixth grade student referred was never initiated by the elementary school nurse who referred the child. Telephone contact with the junior high school nurse was the first step in locating the child. If the junior high school nurse did not know his/her whereabouts, his/her location was obtained from the Monroe County Health Department which has every student listed alphabetically along
with their birthdate, sex, and school location on microfiche.

A system of recording all data collected from the school nurses was devised by this author to avoid duplication of names and follow up information. Every name of the referred or their identifying initials were entered on a roll file with birth date, school attended during the 1979-1980 school year, ethnicity, sex, diagnosis, and treatment.

**Program Development**

School personnel, including members of the City School's physical education and nursing departments, were trained in the screening process at a workshop held at the University of Rochester, March 22, 1979. A time schedule was set up and the program was implemented by City physical education teachers who screened each pupil in the sixth grade individually, separating the sexes in each of the forty-one public schools. Privacy and warmth were insured and adequate illumination aided the observer in viewing the bare spine. A tape was placed on the floor to indicate where the student should stand during the screening, with the screener positioned five feet from the student. The first position required the student to stand erect with the back to the screener, toes placed on the tape, feet together, knees straight, and weight evenly distributed on both feet. Arms were at the sides and the screener checked
for the following indicators of the condition recording any positive signs and symptoms on a screening tally sheet:

1. Unequal shoulder levels; that is, one shoulder higher than the other.
2. Uneven shoulder blades; that is, one protrudes more or is higher than the other.
3. Uneven hip levels; that is, one hip higher than the other.
4. Waist crease deeper on one side than the other.
5. Unequal distance between arms and body.
6. Listing to one side while standing.
7. Unequal elbow levels.

The second screening position required the student to bend forward at the waist ninety (90) degrees. Feet were four inches apart, knees straight, and toes even. Palms of the hands were held together or faced each other, arms hung down and were relaxed. The head was down and the student was examined in this position from the front view, back view, and both sides. The screener checked the following:

1. Rib hump in upper back; that is, asymmetry (uneven contours) of the rib cage or upper back where one side is higher than the other.
2. Lumbar hump in lower back; that is, uneven contours of the rib cage or lower back where one side is higher than the other.

Students that exhibited one or more of these signs were sent to the school nurse. She conducted a second screening
and if signs indicated the condition, the date and information obtained at this screening were recorded on the student's cumulative health record under school nurse's notes. It was also important to note at this time if scoliosis was present in the family. All those with questionable findings in this second screening were referred to their health care provider. The student was informed and, in most cases, their parents were personally contacted for immediate counseling. A written referral (see Appendix 12) was mailed to parents after the school nurse explained information sought from the medical evaluator and stressed the importance of returning the completed referral form to the school nurse, regardless of the findings. The nurses followed up the referral with varying degrees of involvement; some never inquired as to the outcome, while others initiated written reminders, made numerous phone-calls, and/or resorted to home visits. There was, therefore, no continuity as to the nurses' follow up methods.

**Statistical Treatment of Data**

Success of the school scoliosis screening program was determined by assessing the percentage of follow up on the part of those referred as well as the incidence of scoliosis with respect to the sex and ethnicity of the referred. The information obtained through the use of the demographic study
sheet was used to describe the study sample.

The collected data was analyzed using frequency distributions along with percentage tables. Each hypothesis was tested statistically, using a chi-square test which is the technique most frequently used to test null hypotheses situations where this investigator desired to test whether the observed frequencies of events agreed with the theoretical predictions. The chi-square test compares the observed frequencies or those noted in a table with those expected if there were no relationship between the two variables. The chi-square test is an approximate test and becomes more accurate as the expected cell frequencies increase. When there was violation of the assumptions in applying the chi-square test, such as small sample size, the Fisher exact probability test was used as a nonparametric technique for analyzing discrete data.

All results were interpreted at the .05 level of significance. The .05 level was selected because it is considered by many researchers to be at an approximate level for most scientific data.
CHAPTER IV

PRESENTATION, ANALYSIS, AND DISCUSSION OF RESULTS

This chapter includes the presentation, analysis and discussion of the results found in the study. The chapter is treated in three parts: (1) descriptive information, (2) analysis of the hypotheses, and (3) discussion of results.

Descriptive Information

Demographic Information

A scoliosis screening program was undertaken of 3,201 sixth grade students in the Rochester City School District during the 1978-1979 school year. Additional information was requested by this investigator from school nurses as to follow up status, age, sex, and ethnic background of the sixth graders referred for possible scoliosis. From a total of 321 referred students, twenty-seven (27) were never accounted for, due to one school closing and lack of cooperation of a school nurse. Consequently, 294, or ninety-one and six tenths (91.6) percent of the original number referred for possible scoliosis (321), comprised the sample. Therefore, approximately ten (10) percent of the total number screened (3,201) were referred (321) and these

-35-
results compare with other studies where incidence of scoliosis is found in eight (8) to twelve (12) percent of populations screened.

The sample population of 294 students totaled 172 females (58.5 percent) and 122 males (41.5 percent), from forty-one elementary schools. As anticipated, fifty more females than males were referred for possible scoliosis, since scoliosis tends to progress more rapidly and often in females than males for reasons unknown. One theory suggested is hormonal differences, but this has not been substantiated.

Ethnicity of the population revealed 135 Whites, 72 males and 63 females composing nearly half the sample, or forty-five and nine tenths (45.9) percent. The Black ethnic group contributed 128 students, 49 males and 79 females, or forty-three and five tenths (43.5) percent to the sample population. Spanish origin referrals included 7 males and 18 females or 8.5 percent, and Orientals, three males and three females, comprised 2.1 percent. The Black and Spanish groups had considerably more females referred than males, while the Whites had more male referrals than females. The Orientals had an equal sex ratio. Specifically, more White males (72) were referred than females (63), while in the Black population more females (79) were referred compared to males (49). No explanation can be given for this happening or to the Spanish and Oriental distribution of sexes.
Age and Sex Distribution

Sixth grade students ranged in age from 9-16 years with forty-eight (48) percent, or 142 students, being 12-13 years of age. Refer to Table 1.

TABLE 1
Frequency, Percentages, Age and Sex of Scoliosis Referrals

<table>
<thead>
<tr>
<th>Ages</th>
<th>Males</th>
<th>Percent</th>
<th>Percent</th>
<th>Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>(9-10)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>.6</td>
<td>1</td>
</tr>
<tr>
<td>(10-11)</td>
<td>9</td>
<td>7.4</td>
<td>6</td>
<td>3.5</td>
<td>15</td>
</tr>
<tr>
<td>(11-12)</td>
<td>29</td>
<td>23.8</td>
<td>53</td>
<td>30.8</td>
<td>82</td>
</tr>
<tr>
<td>(12-13)</td>
<td>53</td>
<td>43.4</td>
<td>89</td>
<td>51.7</td>
<td>142</td>
</tr>
<tr>
<td>(13-14)</td>
<td>22</td>
<td>18.0</td>
<td>19</td>
<td>11</td>
<td>41</td>
</tr>
<tr>
<td>(14-15)</td>
<td>8</td>
<td>6.6</td>
<td>3</td>
<td>1.8</td>
<td>11</td>
</tr>
<tr>
<td>(15-16)</td>
<td>1</td>
<td>.8</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(16-17)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>.6</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>122</td>
<td>100.0</td>
<td>172</td>
<td>100.0</td>
<td>294</td>
</tr>
</tbody>
</table>

The heaviest concentration of referrals were in this age group, since this is the average age of children in the sixth grade. This age group represented 53 males or 43.4 percent of the total males referred, and 89 females accounting for 51.7 percent of the total female sample referred. The next most common
The age group was 11-12 year olds. The number of males referred in this group was 29, 23.8 percent of the total males, and 53 were females, 30.8 percent of the total females referred. Twenty-eight percent of the referred were grouped in the 11-12 year old category, followed by 14 percent in the 13-14 year olds. Two categories contributed very little to the total; the 10-11 year olds only 5 percent, 14-15 year olds, 4 percent. The remaining one percent of the total number referred was composed of the 9-10, 15-16 and 16-17 year old age groups. One female was nine, one was sixteen years old, and one male was fifteen years old. These numbers contributed very little to the percentage distribution, but did affect the age range of those referred.

Note in Table 1, as the age of referred males increases, the number of referrals also increase up to age 12-13, and then they decrease. The exact same pattern is noticed in the females. This peak is at an age when most adolescents have experienced puberty or are about to undergo physical changes in their bodies. It is interesting to note that even though males experience puberty later than females, both sexes had the greatest number of referrals in the 12-13 year old age group.
Mean and Range of Referred

The mean and range of ages of the students referred for scoliosis according to their follow up status was analyzed. Students completing follow up (143) sought evaluation from their health care provider and returned a completed referral form indicating diagnosis and treatment. The no follow up group of students (131) failed to seek evaluation from their health care provider and, therefore, failed to return the referral form indicating diagnosis and treatment. The no information group (20) could not be located to assess their follow up status. The mean age for each of these three follow up categories was approximately the same, 11.4, 11.3, and 11.8, respectively, pointing out that age was not an important variable in this study. The range of ages in the follow up category was nine to sixteen years of age, the no follow up category, ten to sixteen years of age, and the no information group, ten to thirteen years of age.

Analysis of Hypotheses

Follow Up According to Sex

Less than half (48.6 percent), or 143 students referred, followed through on their referral. This number is smaller than expected, but all studies on action of health referrals
seem close to this percentage. Results also revealed that a greater percentage of males (55.7 percent) had follow up than females, and conversely, a greater percentage of females (50.6 percent) had no follow up than did the males (36.1 percent).

TABLE 2
Frequencies by Sex of Referred Students for Scoliosis in Connection with Follow Up Status

<table>
<thead>
<tr>
<th>Group</th>
<th>Sex (a)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Follow Up</td>
<td>68</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>(59.3)</td>
<td>(83.7)</td>
</tr>
<tr>
<td>No Follow Up</td>
<td>44</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>(54.4)</td>
<td>(76.6)</td>
</tr>
<tr>
<td>No Information</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>(8.3)</td>
<td>(11.7)</td>
</tr>
<tr>
<td>TOTALS</td>
<td>122</td>
<td>172</td>
</tr>
</tbody>
</table>

(a) $X^2(2) = 5.13, P < .0477.$

As shown in Table 2, males with follow up (68) were a larger group than was expected (59.3), but the opposite was true for the females, the expected value (83.7) being greater than the number that actually had follow up (75). The opposite occurred in the no follow up category, more males were expected to have no follow up (54.4) than those that did (44), while more females (87) than expected (76.6) failed to seek follow
up. This is contrary to expected outcomes, but no inference concerning the cause-and-effect can be drawn. It is generally thought that the parents of females are more concerned with their physical appearance than the parents of males. In the no information category, the number of males and females was the same - 10, but fewer males (8.3) and more females (11.7) were expected. Further comparison of the data revealed males with follow up were more than expected, while on the other hand, males that had no follow up were fewer than expected. Females proved to be just the opposite. Those that had follow up were fewer than expected, while those that had no follow up were more than what was expected.

The chi-square test applied to the interrelationship between the sex of the referred and the follow up with 2 df was 6.13, \( P < .0477 \). The \( P \)-value was less than .05, and the difference between the chi-square critical (5.99) and chi-square obtained (6.13) was small. It must be noted that the statistical significance applies to the observed group only and cannot be generalized. Hypothesis one related to sex and follow up stating there is no difference between males and females regarding follow up, no follow up and no information is, therefore, rejected, and the opposite is accepted. There is a difference in males and females regarding their follow up, with males having a greater follow up rate than females.
Follow Up According to Ethnicity

It was interesting to note that 66.6 percent of the Orientals, 57.8 percent of the Whites, 40.6 percent of the Blacks, and 36 percent of the Spanish population referred for scoliosis had follow up. On the other hand, 60 percent of the Spanish, 52.3 percent of the Blacks, 35.5 percent of the Whites, and only 16.7 percent of the Orientals failed to seek evaluation. The percentage distribution pointed out a wide difference in follow up in the ethnic groups.

TABLE 3
The Ethnicity of Students Referred for Scoliosis in Regard to Follow Up

<table>
<thead>
<tr>
<th>Group</th>
<th>Ethnic Background(a)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black</td>
</tr>
<tr>
<td>Follow Up</td>
<td>78 (65.6)</td>
<td>52 (62.3)</td>
</tr>
<tr>
<td>No Follow Up</td>
<td>48 (60.2)</td>
<td>67 (57.0)</td>
</tr>
<tr>
<td>No Information</td>
<td>9 (9.2)</td>
<td>9 (8.7)</td>
</tr>
<tr>
<td>TOTALS</td>
<td>135</td>
<td>128</td>
</tr>
</tbody>
</table>

(a) $x^2(4) = 8.86, p > .05 - .10.$
To test hypothesis two, students were grouped by ethnicity in connection with the follow up, or lack of follow up, sought after referral (Table 3). The expected values are fairly close to the observed values for each ethnic group and each follow up category. More Whites (78) sought follow up care than expected (65.7), 48 had no follow up (60.2 percent) and 9 provided no information. The number of Blacks that received follow up care (52) was lower than the number expected (62.3), but the number that had no follow up care (67) was greater than the number expected (57). The Spanish and Orientals comprised the "Other" group and their follow up number (13) was close to what was expected (15.1). Their no follow up (16) and expected no follow up (13.8) were approximately the same.

Scrutinizing Table 3 further, the different ethnic groups were compared as far as the follow up. More Whites had follow up (78) than were expected, but fewer Blacks (52) actually sought evaluation from their health care provider than expected (62.3). The same was true with the category representing the Spanish and Orientals, with 13 having follow up, while more were expected (15.1).

There were also differences noticed in the no follow up categories among the ethnic groups with Whites having fewer with no follow up (48) than expected (60.2), Blacks having more (67) than expected (57.0) and the "Other" category having
fewer (16) than expected (13.8). There was very little difference found in the no information group in each ethnic group. With 4 df and a chi-square test of 8.86 being more than .05 (between .05 and .10), H02 is accepted as stated; that is, ethnic groups will not differ with respect to follow up, no follow up, and no information. The chi square critical (9.49) was greater than the chi-square obtained (8.86). It is interesting to note that even though percentages generally indicated a low follow up rate in the Black and Spanish population, the hypothesis was tested and accepted.

Diagnosis of Those Followed Up According to Sex

Normal diagnosis refers to negative findings by the referred individual's health care provider in regard to scoliosis, while "Other" diagnosis refers to conditions distinct from scoliosis such as kyphosis, lordosis, or uneven legs. A total of 143 referrals, 68 males and 75 females, out of 294 actually received evaluation from their health care provider, 48.6 percent, or less than half of all those referred. A sum of 51 percent of all students seen for possible scoliosis were diagnosed as normal, with a higher percentage of males (55.9 percent) than females (46.7 percent). Referrals actually diagnosed as having scoliosis totaled 34.4 percent. Twice as many females (48 percent)
as males (23.5 percent) were diagnosed as scoliosis. This supports literature that reveals a higher incidence of scoliosis in females in this age group as compared to males.

Over twenty (20) percent, or fourteen of the 68 males, were diagnosed as having either kyphosis, lordosis, or uneven legs, and only 5.3 percent of the females, or 4 seen for evaluation, had an "Other" diagnosis.

**TABLE 4**

Diagnosis of Referred Students with Further Follow Up According to Sex

<table>
<thead>
<tr>
<th>Group</th>
<th>Male (a)</th>
<th>Female (a)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>38 (34.7)</td>
<td>35 (38.3)</td>
<td>73</td>
</tr>
<tr>
<td>Scoliosis</td>
<td>16 (24.7)</td>
<td>36 (27.3)</td>
<td>52</td>
</tr>
<tr>
<td>Other</td>
<td>14 (8.6)</td>
<td>4 (9.4)</td>
<td>18</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>68</td>
<td>75</td>
<td>143</td>
</tr>
</tbody>
</table>

(a) $\chi^2(2) = 13.06, < P .001$ between .01 (≈.002)

Table 4 shows the relationship of diagnosis and sex. Males observed as having scoliosis (16) were less than expected (24.7); males expected to be diagnosed as normal (34.7) were very close to the observed frequency (38), and fourteen males were diagnosed as having other conditions.
Females were diagnosed as having scoliosis (36) more frequently than expected (27.3), 35 were dismissed as normal when 38.3 were expected and "Other" diagnosis (4) did not occur as often as expected (9.4).

Further examination of Table 4 also reveals the noticeable difference between males and females in regard to scoliosis with only 16 males diagnosed, while scoliosis was found in 36 females. Males and females were diagnosed as normal almost equally with the expected values extremely close to the observed. However, fourteen males and only four females encountered an "Other" diagnosis, while only 8.6 were expected in the males and more, 9.4, in the females. The chi-square test performed with two (2) df and the P-value was less than .05 or between .01 and .001 (=.002); the chi-square obtained was 13.06, greater than 5.99, the chi-square critical value. Hypothesis three is rejected and the opposite is accepted saying there is a relationship between the sex of the followed up student and their diagnosis. Females were diagnosed with scoliosis more often than males.

Diagnosis of Those Followed Up According to Ethnic Background

A total of 143 referrals were followed up with 73 students discharged with negative findings, 18 having an "Other" diagnosis, and 52 being diagnosed as scoliosis.
White students followed up for possible scoliosis were normal in 48.7 percent of the cases, had "Other" diagnosis in 15.4 percent of the cases and actually had scoliosis in 35.9 percent of the referrals. Blacks were diagnosed as having scoliosis in 40.4 percent of the referrals, 51.9 percent were normal and 7.7 percent had "Other" diagnoses. The Spanish had a 66.7 percent dismissal rate, a very low (22.2 percent) diagnosis of scoliosis, and "Other" condition in 11.1 percent of the cases. The Orientals were discharged as normal in 50 percent of the cases, diagnosed as scoliosis in 25 percent and had an "Other" conditions in 25 percent of the instances.

TABLE 5
Frequency for Diagnosis of Those Students Having Follow Up for Scoliosis Regerral in Regard to Ethnicity

<table>
<thead>
<tr>
<th>Group</th>
<th>White(a)</th>
<th>Black(a)</th>
<th>Others(a)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>38 (39.8)</td>
<td>27 (26.6)</td>
<td>8 (6.6)</td>
<td>73</td>
</tr>
<tr>
<td>Scoliosis</td>
<td>28 (28.4)</td>
<td>21 (18.9)</td>
<td>3 (4.7)</td>
<td>52</td>
</tr>
<tr>
<td>Other</td>
<td>12 (9.8 )</td>
<td>4 (6.5  )</td>
<td>2 (1.6)</td>
<td>18</td>
</tr>
<tr>
<td>TOTAL</td>
<td>78</td>
<td>52</td>
<td>13</td>
<td>143</td>
</tr>
</tbody>
</table>

(a) $x^2(4) = 2.79, P > .20$
Spanish and Oriental were combined into the "Other" category since there were so few referred. The observed and expected frequencies of White, Black, and "Other" (Spanish and Oriental) students diagnosed as normal, scoliosis, and "other" were very close in the nine cells (see Table 5). A chi-square test with df 4 applied to the correlation between the ethnicity of the followed up student and the diagnosis revealed 2.79, $P > .20$, more than .05. The chi-square critical (9.49) was greater than the chi-square obtained value (2.79). The hypothesis ($H_0^4$), which stated there was no difference in the diagnosis among ethnic groups of those students followed up for possible scoliosis is accepted. No connection could be shown between the diagnosis and ethnicity; no one diagnosis was more prevalent in any ethnic group.

Treatment for Scoliosis According to Sex

Hypothesis Five states there is no difference in the treatment of scoliosis between males and females. Of the 52 males and females that had treatment, twice as many females (33) as males (16) were under observation, but more than twice as many females (36) as males (16) were diagnosed as having scoliosis. A total of 94.2 percent of the sample were treated by observation where they were seen semi or tri annually by their health care providers for inspection of the back and
comparison of x-rays. Only 5.8 percent required bracing, and these three were all females. The fact that three braces were prescribed for females and none for males could possibly be due to scoliosis progressing more rapidly and to a greater degree in females. It is interesting to note that not one of the diagnosed patients required surgery, probably due to screening done at an early age and prior to, or at the onset of, puberty and the growth spurt. Scoliosis is known to progress rapidly during puberty or after the age of the average sixth grade student.

Originally, 294 students were referred for possible scoliosis, and from a total of 143 who had follow up, actually only 52 required treatment (36.4 percent) in the form of observation or bracing. The chi-square test applied was invalid since the sample size and the expected frequencies were too small. Consequently, a Fisher-exact test was applied to the data. The P-value was more than .05, or .32 calculated by the Fisher-exact test, and H0 was accepted as the test revealed that males and females did not differ in the treatment prescribed, i.e., observation and bracing, once the diagnosis of scoliosis had been made.
Treatment for Scoliosis According to Ethnic Background

That there is no difference in the treatment of scoliosis among ethnic groups was the testing of hypothesis six. Students that were diagnosed as having scoliosis requiring treatment (52) were separated into two categories, namely Whites and "Others" (Blacks, Spanish, and Orientals). The percentage distribution was approximately the same when treatment was considered with Whites and "Others" under observation in 93.1 percent and 95.6 percent of the cases, respectively. Braces were prescribed in 6.9 percent of the Whites and 4.4 percent of the "Others." When both ethnic groups were examined concurrently, 94.2 percent of the total 52 students treated were under observation and only 5.8 percent in braces.

The expected frequencies and sample totals were too small to test by chi-square and the Fisher-exact test was applied to test H06. Because of the size of the sample, all non Whites were again combined into an "Other" category. The treatment prescribed most frequently was observation, which was expected since the screening was done at an early age. Braces were prescribed in two Whites and one "Other" and no conclusions can be drawn since the number involved in this group is so small. The P value was .58 calculated by the Fisher-exact test, greater than the .05 level of significance and these results indicate the acceptance of the hypothesis that ethnicity has nothing to do with the prescribed treatment. The
above conclusion is for the observed group only.

Discussion of Results

Investigation of demographic information revealed that 294 students referred for scoliosis following the mandate for school scoliosis screening, had a low follow up rate (44.6 percent, or less than half), indicating a definite need for revision of the referral system and follow up process. It is encouraging to note that those diagnosed as having scoliosis were detected early enough (during the sixth grade) to receive conservative rather than radical treatment.

The age of the referred was not an important variable since the mean was the same in each follow up category, but the wide age distribution was unexpected since there was one student in the nine to ten year old group, one student in the fifteen-sixteen year old age group, and one in the sixteen-seventeen year old category. The sources for this information are reliable and verified, but the extreme age distribution seems unusual. The fifteen-sixteen year old could be explained by "staying back," and the nine-ten year old could have been a gifted child, or a transfer from a foreign educational system having a more advanced curriculum than the United States.

The scoliosis referrals were ineffective in motivating parents to seek health care. The poor response may be due to
any one of the following reasons:

1. The lack of any effort on the part of the parents to seek any type of follow up care.

2. The lack of follow up by parents who obtained evaluation from their health care provider, but failed to notify the school nurse or return the written referral form.

3. The lack of urgency attached to the referral by the families who received them.

4. The lack of understanding about the term scoliosis and the necessity of follow up on the part of the parents.

5. The fear of positive diagnosis and radical treatment by the parents of those referred.


7. The lack of knowledge as to where to obtain consultation, since the school nurse cannot ethically recommend, but only list a particular medical individual or facility.

8. The lack of parent initiated communication rather than nurse initiated communication. Parents do not feel the responsibility for contacting the nurse.

9. Parent's lack of transportation to the health care provider.

10. The lack of parent-child communication in regard to health defects.

11. The lack of follow up on the part of the school nurse. The communication initiated by the school nurse to the parent or student in regard to the outcome of the referral could have been insufficient.

12. The lack of student initiated communication where the student understands his/her responsibility in reporting the outcome of the follow up to the school nurse.
In a study conducted in ten schools in the Rochester City School District in 1974-1975, a 53 percent non response to health referrals other than vision and hearing, such as speech, dental, or sickle cell anemia, was noted. Along the same line, the Community Health Nursing Annual Report in 1976-1977 noted a 69 percent lack of response to vision referrals and a 21 percent non response to hearing referrals. It would seem that referrals for scoliosis would also have a slow referral success rate. It is this investigator's opinion that all referral systems will continue to falter unless more direct contact between the school health personnel and the family is initiated. Various studies provide additional evidence of poor referral response. Bauman (1976) stated that 58 percent of the sample population in North Carolina had not initiated follow up indicated as needed on referrals. Cauffman (1967) discovered 34 percent of families studied in California had not responded to referrals and in a subsequent study (Cauffman, 1969), 51 percent non response group.

This particular investigation revealed statistically there was no significant influence of ethnicity on either follow up, diagnosis, or treatment. When statistical tests were employed to test $H_0^2$, $H_0^4$, and $H_0^6$, certain ethnic groups had to be combined to increase sample sizes. In the consideration of follow up and ethnicity in $H_0^2$, the ethnic categories
were reduced to White, Black, and "Others" which contained Spanish and Oriental. The same was true in H0₄, when diagnosis of ethnic groups were considered. In the examination of the treatment of the diagnosis scoliosis students according to their ethnicity in H0₆, the categories were reduced to Whites and "Others" (Blacks, Spanish, and Orientals) due to the small sample size. However, it must be noted that percentage distributions were calculated into four ethnic groups, mainly Whites, Blacks, Spanish, and Orientals.

One ethnic group did not tend to have scoliosis more than the other. Although it was shown statistically that one ethnic group did not follow up more than the others on their referrals, there was a higher percentage of no follow up among two ethnic groups, namely Black (52.3 percent) and Spanish (60.7 percent). It is this investigator's past experience also as a Public Health Nurse and School Nurse-Teacher, that certain ethnic groups do tend to act on health referrals more than others. It seems that action is synonymous with financial security. When there are economic hardships, school health referrals are given low priority when weighed against food, clothing and shelter needs. Blacks and Orientals with a high percentage of non response to the referrals could lack financial security in this urban setting of lower social classes. H₀₂, H₀₄, and H₀₆, that stated that there would be no difference statistically in ethnic groups in regard to their follow up,
diagnosis, and treatment, were accepted as stated, and although differences were found in the percentage distributions, no differences were found statistically.

The sex of the referred had a definite bearing in certain areas. Initially, more females were referred for scoliosis, but had a lower follow up rate than males. Hypothesis one was rejected saying there is a difference between the sexes regarding their follow up, and that males had a greater follow up rate to their referrals than females. This is inconsistent with this investigator's observation and other researchers in the field as it is thought parents are more concerned about their daughters cosmetically than sons. This investigation demonstrated the parents of males sought evaluation more often than the parents of females. The diagnosis for scoliosis was made twice as often in the female population, but treatment prescribed was not influenced by the sex of the patients. And finally, Hypothesis Five, which stated there was no difference between males and females in regard to the treatment for scoliosis, is accepted since the sex of the student with scoliosis did not influence the treatment prescribed.

The high percentage (51 percent) of all students seen for possible scoliosis and diagnosed as normal could be attributable to inexperience, or over referral, on the part of the
school nurse in the first year of the scoliosis screening program or failure of physicians to diagnose properly without an x-ray of the spinal column. The referral sent to parents suggested that an anterior-posterior x-ray be obtained and provided a space for the recording of the findings, but often this diagnostic tool was avoided.

Results compare favorably with other published studies. However, the validity of the findings might have been strengthened if the study design had allowed for randomization of groups (random sampling), or if a comparison or control group had been provided. Bias is presumed, since the instrument used was designed and interpreted by the researcher. It is this researcher's opinion that the outcome of this study might well have been different if the data was collected in another geographical area. For example, a higher percentage of follow up is noticed in this author's own district of a higher economic status, where affluent parents seek follow up promptly. It has been this investigator's experience that financial security does indeed have a bearing on the follow up rate for health referrals along with commitment of the referee.
CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine the effectiveness of the school screening referrals for scoliosis. Variables of age, sex, and ethnic background were identified and measured as to their influence on the rate of the follow up, diagnosis, and treatment. From 3,201 sixth graders in the Rochester City School District in the 1978-1979 school year, approximately ten percent, or three hundred and twenty-one, were referred as a result of a scoliosis screening program. Twenty-seven of the referred could not be included in this study and, therefore, the study group was two hundred and ninety-four students. Chi-square tests were used to test the hypotheses and the Fisher-exact test was applied to the hypotheses when the sample sizes were too small. There was a forty-eight and six tenths (48.6) percent follow up rate, a forty-four and sixth tenths (44.6) percent no follow up rate, and a six and eight tenths (6.8) percent group where there was no information available. This follow up rate (48.6 percent) on the scoliosis referrals was low, but studies
assessing the effectiveness of school health referrals support these findings. More females than males were picked up on the initial screening for deviation of the spine. From those students referred, and accounted for (294), one hundred and forty-three went for medical verification and fifty-two of those evaluated were diagnosed as having scoliosis. None of the referred who were diagnosed as having scoliosis required surgery. However, forty-eight required observation semi or tri annually and three Milwaukee braces were prescribed to females.

Males had a higher follow up rate to the referral than females and a statistical difference was noted when a chi-square test was applied to the inter-relationship between the sex of the referred and the follow up status, thus rejecting the hypothesis that there was no difference between males and females in regard to follow up, no follow up, and no information. This result was unexpected since it is generally thought that parents of female children are more attentive to their children's physical appearance than parents of males.

Statistically, ethnicity of those referred did not influence the follow up rate significantly. Ethnic groups do not differ with respect to follow up, no follow up, and no information. However, the percentage distribution revealed a large percentage of Blacks and Spanish who failed to obtain follow up care.
There was a statistical difference between males and females with respect to their diagnosis, with females being diagnosed as having scoliosis more frequently than males. Females and males have an equal incidence of scoliosis to begin with, but it progresses more often and more rapidly in females than in males. There was no statistical difference in the diagnosis between the various ethnic groups. Very little research has been conducted in this area and to this date, scoliosis is not known to be more prevalent in any one ethnic group. It was also established that the sex and ethnicity of the referred did not influence the treatment once the scoliosis was diagnosed. Treatment has never been selected according to the sex or ethnic background of the diagnosed.

Conclusions

Within the limitations of this study, the following conclusions apply to the population investigated.

1. The follow up system for scoliosis referrals was ineffective in the Rochester City School District in the 1978-1979 school year. Only forty-eight and six tenths (48.6) percent or one hundred and forty-three of the original sample of two hundred and ninety-four had follow up, forty-four and six tenths (44.6) percent or two hundred and thirty-one had no
follow up, and six and eight tenths (6.8) percent or twenty contributed no information.

2. **Age of the referred did not influence follow up.** Age of the child did not influence the parent's decision to seek follow up care. The mean age was approximately the same in all categories - follow up, eleven and four tenths (11.4); no follow up, eleven and three tenths (11.3); and, no information, eleven and eight tenths (11.8).

3. More females than males were referred for possible scoliosis than males. From a total of 294 students referred, fifty more females (172) were referred than males (122). Scoliosis tends to be more prevalent in females than males in the puberty or post-puberty stage which was the period screened.

4. More students in the age group from eleven to thirteen were referred than in any other age group. This age group, however, is the norm for sixth grade level.

5. **Sex of the referred does determine the follow up.** A chi-square analysis revealed that parents of males are more attentive to referrals than those of females. Males had a greater percentage of follow up, fifty-five and seven tenths (55.7) percent than females, forty-three and one tenth (43.1) percent. It was generally felt that parents are more attentive to the physical appearance of daughters rather than sons, but the opposite occurred in this study.

6. **Follow up was not greater in any particular ethnic group.** Ethnicity did not determine action on a referral.
A chi-square analysis revealed no significant difference existed between the different ethnic groups of Whites, Blacks, and Others (Spanish and Oriental). However, a greater percentage of Blacks, fifty-two and three tenths (52.3) percent and Spanish, sixty (60) percent, failed to have follow up care.

7. There was a difference in the diagnosis in relation to sex. A chi-square analysis revealed that more females had been diagnosed for scoliosis than males. This finding is supported by other research in the field as the condition tends to progress more often and more rapidly in females.

8. Scoliosis was not more prevalent in any particular ethnic group. Data revealed no significant statistical difference among ethnic groups when the diagnosis of scoliosis was completed. Scoliosis was present in thirty-five and nine tenths (35.9) percent of the Whites, forty and four tenths (40.4) percent of the Blacks, twenty-five (25) percent of the Orientals, and only twenty-two and two tenths (22.2) percent of the Spanish. However, more Whites and Blacks were referred initially than Spanish and Orientals.

9. There was no difference between the sexes in regard to treatment for scoliosis. A Fisher-exact statistical test revealed no significant difference between males and females in regard to the treatment (Observation or Bracing) prescribed for scoliosis.
10. Treatment for scoliosis does not depend on the ethnicity of the referred. Data revealed no significant statistical difference among the different ethnic groups (Whites, Blacks, and "Others" - Spanish and Oriental) in regard to the treatment prescribed for scoliosis.

Recommendations

Recommendations for Further Research

Based on the results of this study, the following recommendations are suggested for further research.

1. After complete revision of the scoliosis screening program, repeat the study to determine if greater follow up occurs in the 1980-1981 school year.

2. Design a study to determine why the follow up rate on referrals was so low. The families who failed to seek evaluation would be contacted to determine the reasons for lack of follow up on the referrals.

3. Design a study to determine if health care providers are dealing with each referral correctly, including an x-ray in the exam before arriving at a diagnosis. The large number that were diagnosed as normal indicates either "overcall" by the screeners or "undercall" by the evaluator.
Recommendations for Practical Application

Based on the results of this study, the following recommendations are offered for follow up programs of school scoliosis referrals.

1. Revision of the follow up program. Once a referral is sent, a definite timetable should be established by the school nurse, thereby guaranteeing medical intervention. Greater communication between the nurse, family, and student is necessary and constant inquiry would prompt an answer and remind the family to seek evaluation.

2. Send a letter to parents, explaining scoliosis and the screening program with an invitation to a parent education program in the home school. For the parent information night, rent the 66/slide sound carousel "Watch That Curve" from the publication department of The Scoliosis Association, Inc. for viewing. The cost of rental, $23.00, includes handling and shipping, and would be covered by the Parent-Teacher Association's funds.

3. Conduct a pupil education program during science or health education class that would acquaint students to be screened with scoliosis and the treatment available. In the meantime, order 3,000 Scoliosis Fact Sheets from The Scoliosis Association, Inc. for distribution to students after the class. A voucher of $80.00 to cover the cost would be obtained from the financial department of the city school district in advance.
4. Encourage screening program completion in the early months of the school year, so that all follow up by health care providers and school nurses is completed in the early spring. Written referral forms should be back in the nurse's office by April of the school year.

5. Move the screening into the seventh grade since only one grade is to receive the service in the city school district. This would alleviate transfers to a new school and problems encountered due to relocation of the referred sixth graders.

6. Design a screening check list to be used district wide by the screener for a student who displays one or more of the signs and symptoms of scoliosis. The heading of each sheet would include a place to be filled in with the name of the screened, age, date, and homeroom. The signs and symptoms of scoliosis would be listed with boxes to be checked when the symptom presented itself. The rescreener would then consult that check list only if he/she noticed findings of the condition, to compare and record results. The referral would then be reinforced with two opinions.

7. Include scoliosis in the conditions listed on the family health history forms to determine if scoliosis is present in any other family members. The condition is more apt to manifest itself in families where the condition is present in siblings or parents.


Dickson, J.H., M.D. and Erwin, W.D., M.D. Scoliosis: What is it? Texas Medicine, 74(5), 1978, 57-68.


Haake, W.P., M.D. Personal Interview.


APPENDICES
APPENDIX D
COBB INSTRUMENT

SCOLIOSIS
MEASUREMENT OF CURVE
J. R. COBB, M. D.

1 BOTTOM VERTEBRA:
LOWEST ONE WHOSE BOTTOM TILTS
TO CONCAVITY OF CURVE.

2 ERECT PERPENDICULAR FROM
BOTTOM OF BOTTOM VERTEBRA.

3 TOP VERTEBRA:
HIGHEST ONE WHOSE TOP TILTS
TO CONCAVITY OF CURVE.

4 DROP PERPENDICULAR FROM
TOP OF TOP VERTEBRA.

5 MEASURE INTERSECTING ANGLE.

H.C. ULRICH Germany
APPENDIX E

MILWAUKEE BRACE
APPENDIX H
ORIGINAL TALLY SHEET

<table>
<thead>
<tr>
<th>Grade &amp; Sex</th>
<th>Total Number Screened</th>
<th>Number Screened With Negative Findings</th>
<th>Number of Abnormal Curvatures Previously Known and Not Referred</th>
<th>Number of Questionable Findings Not Referred This Screening</th>
<th>Number Screened With Positive Findings and Referred This Screening</th>
<th>Diagnosis</th>
<th>Recommended Scoliosis Treatment</th>
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*Column 1 is the sum of Columns 2, 3, 4 & 5. **Column 6 is the sum of Columns 9, 10, 11 & 12.
# Scoliosis

City Schools - 6th grade

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TO: Robert Wood, M.D.
    Ms. Lucy Carpentier
    Ms. Peg Crowley
    Ms. Sharon Ingals
    Ms. Wanda Wright

FROM: Louis A. Goldstein, M.D.

DATE: September 19, 1979


The data sheets received from the various schools on the School Screening Program have been analyzed. We are encouraged with the results of 1978-79 screening program. The figures indicate that as a result of the School Screening Workshop and the summary sheets sent in, the the screening personnel that over 35,000 children were screened for the early detection of scoliosis in Monroe and surrounding counties.

You will be interested to know that a total of 35,349 children were screened, including 1,815 in parochial schools. 1,482 children were referred for confirmation of diagnosis by physician. A definite diagnosis of scoliosis was made in 509 of these. As a result, 419 children remain under observation to see whether they develop evidence of a progressive curvature. 33 children have been braced and 8 have had surgical treatment. As a first time effort, we must all agree that this has been very worthwhile. I am sure that some of these children would have gone on to more severe deformity if they had not been picked up in the screening program.

I thought there would be some advantage in another study to get more definitive information from this data. This can be done by a follow-up on the sixth graders screened in the 1978-79 program in the Rochester City School District. I would very much appreciate your cooperation in collection of this data.

Sincerely yours,

Louis A. Goldstein, M.D.
Professor of Orthopaedics
Head, Spine Surgery Section

LAG/Imp -78-
Dear Nurses,

We are encouraged with the results of the 1978-1979 school screening program for Scoliosis.

As a separate study, we have chosen a follow-up of last year's 6th graders who were referred for possible curvature of the spine, in the city school district. We ask your cooperation in the collection of the data.

Dr. Goldstein and I are interested in the diagnosis, and if positive, the treatment prescribed.

Enclosed are copies of your original summary sheets and a new survey form to be completed. If you have not followed up the referral, could you please indicate the child's name, birthdate, and the school he or she attends now? Please call on me for any help in the follow-up.

I have afternoons free and could help you locate the referred and the information needed. When all this data is collected, we will then be able to judge the effectiveness of the referral program.

Would it be too much trouble to ask you for the new summary sheet by November 15th? Please return them to Mrs. Carpentier.

Thank you so much for all your efforts to aid in the early detection of scoliosis, thereby eliminating the need for surgery.

Sincerely,

[Signature]
Dear Parents:

We have recently completed the spine deformity screening and your child appears to have a possible curvature of the spine. This problem should be checked by your family doctor or pediatrician and they may refer you to an orthopedic surgeon for evaluation and treatment. If you do not have a personal physician, please contact your school nurse.

It is important that this matter receives your attention.

Sincerely,

School Community Health Nurse

Physicians Findings and Recommendations:

I have examined ___________________________ on _______
( ) Standing (anterior-posterior x-ray) shows: ________________________

( ) No significant findings at this time __________________________

( ) Need for further evaluation __________________________

( ) Re-examination or treatment recommend (if so, date ________________)

Additional comments: __________________________

Signed __________________________

Address __________________________

Telephone Number __________________________

Please return this form to the school nurse.