A Study To Determine The Incidence Of Scoliosis In School Children Within The Metropolis Of Johannesburg, South Africa

A dissertation presented to the Faculty of Health Sciences, University Of Johannesburg,
In partial fulfilment of the Masters degree in Technology: Chiropractic
By

Andrew Hendrik Janse van Rensburg
(Student number: 809528189)

Supervisor: __________________________
Dr. M. A. Buchholtz
[M. Tech Chiropractic CCFC, (S.A.)]

Co-Supervisor: __________________________
Dr. M. Moodley
[M Tech Chiropractic, (S.A.)]

Johannesburg 2006
DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Technology at the University Of Johannesburg. This work has not been submitted before for any degree or examination in any other Technikon or University.

Signature of Candidate: _______________________________________________

On this ____________________ the ____________ of ___________________ 2006

Signature of Supervisor: ________________________________________________

On this ____________________ the ____________ of ___________________ 2006

Signature of Co-Supervisor: ____________________________________________

On this ____________________ the ____________ of ___________________ 2006
DEDICATION

Dedication of this work and everything that ascended me to this point is to:

My mother, Paddy van Rensburg, without whom my life would be intolerable, who has given me the most valuable of life’s lessons and through great sacrifice has afforded me the opportunity to pursue my dreams. Thank you for your unwavering love, strength and patience. Without you none of this would have been possible. I hope to make you proud.

To my heavenly Father I give all my thanks for providing me the gift of such an amazing mother and for your eternal presence, love, guidance and protection. This work and all I have achieved in this life is made possible through you. I aspire to honour you in all that I do.

To my two best friends, Candice and Ian, thank you for always being there for me.
I would most sincerely like to thank the following people for their valuable and unforgettable input into my journey of growth and knowledge:

Dr. Mike, thank you for your immense patience during this long journey and your incredible efficiency with the corrections and help. You’ve made this process so much easier for me.

Dr. Opperman, thank you for being the one to play the messenger. You have been a fantastic help in this process.

Dr. Moodley, thank you for being my conscience and spurring me on to get finished. Thank you for your availability and help during my very long journey.

To all my friends and family for your encouragement and motivation through the years, I am eternally grateful.

To Dr. Urli and Dr. Pronto, thank you for your motivation, help and support. It was an honour to work with you both.

Adam and Riette at Statcon, thank you for your efficiency with my stats and making it so easy to understand.

To Dr. Yelverton, thank you for lighting that firecracker that got me going. It was just what I needed to finally complete this thesis.

Finally to all the heads of the schools and all the children that took part in this study, thank you so very much for all your help.
ABSTRACT

OBJECTIVE

To determine the incidence of scoliosis affecting primary school children aged ten to eleven in the metropolis of Johannesburg, South Africa, by using clinical screening methods. Comparisons are drawn between gender, race groups and government and independent primary schools.

DESIGN

A case study approach, incorporating the clinical screening of primary school children aged ten to eleven years, of all races and both genders, in both government and independent schools, was used. Thirty-two primary schools were considered (sixteen government and sixteen independent primary schools) out of which one class of pupils satisfying the age criteria of the sample group was randomly selected for screening.

PROCEDURE

Children involved in the study were screened for scoliosis using two methods, namely Adams’ Position and the Erect Position. Screening in the Erect Position made use of a vertical plumb line to detect deviation of the spine from the midline. Screening for scoliosis using the Adams’ Position required the subject to flex his/her trunk forward so that the skyline of the back could be observed for the presence of a rib hump unilaterally. At least one of the abovementioned tests had to be positive to make the diagnosis of scoliosis. Subjects’ age, gender, race, school and test results were captured on data collection forms for statistical evaluation.

CONCLUSIONS

The incidence of scoliosis, including all forms of the disease, was found to be far greater in the primary schools of Johannesburg than what statistics for the United States and world incidence indicated. Scoliosis was found to be most prevalent in independent primary schools and in White children, with socio-economic status having a seemingly strong influence on the prevalence of scoliosis. The male to female ratio of scoliosis was found to be statistically equal.
# TABLE OF CONTENTS

DECLARATION . . . . . . . . . . . . . . II

DEDICATION . . . . . . . . . . . . . . III

ACKNOWLEDGEMENTS . . . . . . . . . IV

ABSTRACT . . . . . . . . . . . . . . . . V

LIST OF FIGURES . . . . . . . . . . . IX

LIST OF TABLES . . . . . . . . . . . X

LIST OF GRAPHS . . . . . . . . . . XII

LIST OF APPENDICES . . . . . . . . XIII

CHAPTER ONE . INTRODUCTION . . . . 1

1.1 INTRODUCTION . . . . . . . . . 2

1.2 AIM OF THE STUDY . . . . . . . 2
CHAPTER TWO  . LITERATURE REVIEW  . 4
2.1 ANATOMY OF SCOLIOSIS  . . . . . . 5
2.1.1 Classification and Types of Scoliosis  . . . . . 8
2.2 CLINICAL SCREENING OF SCOLIOSIS . . . 11
2.3 TREATMENT OPTIONS FOR SCOLIOSIS  . . 14
2.4 STATISTICS OF SCOLIOSIS  . . . . . . 18
2.5 SCHOOL HEALTH PROGRAMS
    IN SOUTH AFRICA  . . . . . . . . . 22
2.6 CLASSIFICATION OF RACE GROUPS
    IN SOUTH AFRICA  . . . . . . . . . 22

CHAPTER THREE  . METHODOLOGY  . . 23
3.1 INTRODUCTION  . . . . . . . . . . . 24
3.2 STUDY DESIGN  . . . . . . . . . . . 24
3.3 SAMPLE GROUP  . . . . . . . . . . . 24
3.4 INFORMED CONSENT.  . . . . . . . . 24
3.5 INCLUSION CRITERIA  . . . . . . . . 25
3.6 EXCLUSION CRITERIA  . . . . . . . . 25
3.7 SAMPLE SIZE  . . . . . . . . . . . 25
3.8 PROCEDURE.  . . . . . . . . . . . 25
3.9 DATA ANALYSIS.  . . . . . . . . . 28

CHAPTER FOUR  . RESULTS.  . . . . 29
4.1 INTRODUCTION  . . . . . . . . . . . 30
4.2 DEMOGRAPHICS  . . . . . . . . . . . 30
4.3 SCOLIOSIS SCREENING RESULTS  . . . . 33
LIST OF FIGURES

FIGURE 2.1 Normal Spinal Curves ........................................... 5
FIGURE 2.2 Types of Curvatures in Scoliosis .......................... 6
FIGURE 2.3 Effect of Lateral Bending on Structural and Functional Curves .............................................. 7
FIGURE 2.4 Effect of Scoliosis on Vertebral Bodies ..................... 9
FIGURE 2.5 A) Photograph of Infantile Idiopathic Scoliosis ........ 10
       B) Rib Hump Formation ............................................. 10
FIGURE 2.6 Progression of Curvature in Adolescent Idiopathic Scoliosis ..................................................... 11
FIGURE 2.7 A) Orientation of Posterior Plumb Line ................. 12
       B) Posterior Observation of Scoliosis ........................... 12
FIGURE 2.8 Demonstration of Adams’ Position ......................... 13
FIGURE 2.9 Adolescent Idiopathic Scoliosis Before and After Corrective Surgery .................................... 14
FIGURE 2.10 Patient Consultation and Bracing ......................... 15
FIGURE 2.11 Bracing for Scoliosis ......................................... 16
FIGURE 2.12 Radiograph Before and After Corrective Surgery for Adolescent Idiopathic Scoliosis ............... 17
FIGURE 2.13 Customized brace ........................................... 18
FIGURE 2.14 Observation and Radiograph of Scoliosis ............... 19
FIGURE 2.15 Infantile Idiopathic Scoliosis .............................. 20
FIGURE 2.16 Three Dimensional Projection of an MRI of Scoliosis ......................................................... 21
FIGURE 3.1 Correct Postural Alignment of the Spine ................. 26
FIGURE 3.2 Demonstration the Use of a Plumb Line .................. 26
FIGURE 3.3 Demonstration of Adams’ Position ........................ 27
FIGURE 3.4 Idiopathic Scoliosis ........................................ 28
LIST OF TABLES

TABLE 4.2.1 Number of Participants from Independent and Government Schools . . . . . . . . . . . . 30
TABLE 4.2.2 Number of Children in Each Age Group . . . . . . . . . . . . 31
TABLE 4.2.3 Number of Children in Each Gender . . . . . . . . . . . . 31
TABLE 4.2.4 Number of Children from Each Race Group . . . . . . . . . . . 32
TABLE 4.2.5 Number of Children from Revised Race Groups . . . . . . . . . . . 32
TABLE 4.3.1 Results of Screening in Adams’ Position . . . . . . . . . . . . 33
TABLE 4.3.2 Results of Screening in the Erect Position . . . . . . . . . . . . 33
TABLE 4.3.3 Comparison of Government and Independent Schools for Adams’ Position . . . . . . . . . . . . 34
TABLE 4.3.4 Comparison of Government and Independent Schools for the Erect Position . . . . . . . . . . . . 35
TABLE 4.3.5 Comparison of Each Gender for Adams’ Position . . . . . . . . . . . . 36
TABLE 4.3.6 Comparison of Each Gender for the Erect Position . . . . . . . . . . . . 36
TABLE 4.3.7 Comparison of Each Race Group for Adams’ Position . . . . . . . . . . . . 37
TABLE 4.3.8 Comparison of Each Race Group for
Adams’ Position (Revised Race Groups) . . . . . . 38

TABLE 4.3.9 Comparison of Each Race Group for
the Erect Position . . . . . . . . . . . . . . . . . . . . . . . 39

TABLE 4.3.10 Comparison of Each Race Group for
the Erect Position (Revised Race Groups) . . . . . . . 40
LIST OF GRAPHS

GRAPH 4.3.1 Comparison of Independent and Government Schools . . . . . . . . . . . . . 41

GRAPH 4.3.2 Comparison Between Genders. . . . . . . . . . . 42

GRAPH 4.3.3 Comparison Between Revised Race Groups . . . . . . . . . . . . . . . 43
## LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX A</td>
<td>School Consent Form</td>
<td>56</td>
</tr>
<tr>
<td>APPENDIX B</td>
<td>Participant Information and Consent Form</td>
<td>58</td>
</tr>
<tr>
<td>APPENDIX C</td>
<td>Data Collection Form</td>
<td>60</td>
</tr>
</tbody>
</table>
CHAPTER ONE

INTRODUCTION
1.1 Introduction

Idiopathic scoliosis has an incidence of 2 to 3% in children aged 10 to 16 years of age in the United States of America (Beers and Berkow 1999). Worldwide prevalence, including all forms of scoliosis, is said to be 1% of the population (Dawson 2005)

From discussions with teachers and principals at the primary schools involved in this study and from past personal experience, spinal screening for scoliosis in South African primary schools was implemented in the past but has been discontinued for approximately 10 years. There appears to be no record of the number of children screened, what ages they were or which race they were. Only government schools received this service. Some private schools implemented these screenings through private medical staff but kept no records of their findings. Due to the lack of records no incidence for scoliosis in South Africa can be calculated or obtained from past records.

CureResearch.com (2005) has extrapolated incidence statistics for scoliosis for all countries throughout the world based on United States, United Kingdom, Canadian or Australian statistics. The extrapolation is “automated and does not take into account any genetic, cultural, environmental, social, racial or other differences…”. According to the abovementioned document an incidence of 133 345 out of a population of 44 448 470 for scoliosis has been extrapolated for South Africa. A specific study into the incidence of scoliosis in South Africa has not been found. It is this lack of information that has been responsible for prompting this study.

1.2 Aim of the Study

The aim of this study was to determine the incidence of scoliosis affecting primary school children in South Africa. Due to logistical constraints, only primary school children in the greater metropolis of Johannesburg were used in this study. The study is statistical in nature and aims to provide a foundation of information as to the incidence of scoliosis in South Africa.

From this study we are able to draw comparisons with similar regions and groups in other countries as to the incidence of scoliosis. Further, similar studies in other regions and socio-economic groups are required to obtain a true reflection of the incidence of scoliosis in South Africa.
Unfortunately no comparison can be made with past statistics in South Africa due to the lack of information regarding scoliosis statistics in South Africa. These comparisons had to be made using statistics from other countries. Determining an increase or decrease in scoliosis in South Africa is thus virtually impossible.
CHAPTER TWO

LITERATURE REVIEW
2.1 Anatomy of Scoliosis

The normal curvatures of the spine occur at the cervical, thoracic and lumbar regions in a median plane. Viewed posteriorly the spine appears straight, however, in a scoliotic spine a “C” or “S” shape is visible from a posterior view (Dawson 2005).

![Diagram of normal spinal curves](SpineUniverse.com 2005)

Fig2.1 Shows normal spinal curves (SpineUniverse.com 2005).

The definition for scoliosis is “any deviation of the spine from the midsagittal plane” (Yochum and Rowe 1996), or lateral curvature of the spine (Cassella and Hall 1991; Merenstein et al. 1994). Scoliotic curvatures may exist in the cervical spine alone (torticollis), in the thoracic spine alone, in the thoracolumbar area or in the lumbar spine alone (Magee 2002; Merenstein et al. 1994). Most often, however, two or more curvatures are seen. A primary scoliotic curvature is the first or earliest curve to appear and is usually the largest. A compensatory curve or secondary curve, which may be much smaller than the primary curve, occurs above or below the primary curve resulting in a functional three-curve scoliosis. This functions as an adaptation of the spine to maintain normal body alignment (Yochum and Rowe 1996; Lehnert-Schroth1992; Cassella and Hall 1991; Merenstein et al 1994).
The apex of the scoliotic curve designates its pattern, that is, a curve which has a convexity towards the right with its apex in the thoracic spine would be a right thoracic curve. Junctional curvatures have their apices at the junction, example cervicothoracic or thoracolumbar curvatures (Magee 2002; Merenstein et al 1994).

![Diagram of various spinal curves](image)

Fig 2.2 A) Normal spinal alignment; B) Cervical curve; C) Cervicothoracic curve; D) Thoracic curve; E) Thoracolumbar curve; F) Lumbar curve; G) Lumbosacral curve; H) Double lumbar and thoracic curves (Yochum and Rowe 1996).

Scoliosis has a myriad of complications which occur with and without treatment. Non-treatment related complications include the following:

a) Cardiopulmonary complications in severe thoracic curvatures as a result of restricted rib cage movement which results in pulmonary hypertension with subsequent right and left-sided congestive heart failure. Altered lung function also predisposes the patient to pulmonary infection and dyspnea.

b) Degenerative spinal arthritis.

c) Curvature progression.

d) Fatigue and joint dysfunction syndromes.

e) Radiation exposure due to the number of radiographs taken throughout the patient’s life.

Treatment-related complications:

a) Non-surgical complications are largely due to bracing of the patient which causes psychological stress and skin irritations.

b) Surgical complications include cardiac arrest and spinal cord injury during surgery. Pseudoarthrosis of the fusion, instrumentation failure and infection are the most common postoperative complications.

c) Radiation exposure. (Yochum and Rowe 1996)
Scoliosis can be classified according to its aetiology or according to its location. Classification by location is as follows: cervical, cervicothoracic, thoracic, thoracolumbar, lumbar, lumbosacral. The more accepted method of classification is the aetiological classification of scoliosis that is subdivided into 2 categories namely structural scoliosis and non-structural scoliosis (Yochum and Rowe 1996).

Structural scoliosis results in abnormal flexibility and lateral bending is asymmetric. This type of scoliosis may be progressive and the scoliotic curve does not disappear on forward flexion (Magee 2002), the deviation is permanent and the spine cannot return to the neutral position (Haldeman 1992). With structural scoliosis the lateral curvature is fixed and does not correct on recumbent lateral-bending radiographic studies (Yochum and Rowe 1996; Cassella and Hall 1991). A defining sign is decreased spinal mobility on the convex side of the curve (Lehnert-Schroth 1992).

Non-structural scoliosis has no bony deformity and is not progressive. Also known as a functional scoliosis or postural scoliosis, this type of scoliosis is a compensation for other abnormalities such as leg length inequality or antalgic listing due to intervertebral disc herniation, lumbar facet pain or sacroiliac pain. There is no vertebral rotation or rib hump deformity (Bickley and Hoekelman 1999; Cassella and Hall 1991; Jolly 1981; Heese 1995; Merenstein et al 1994). Functional scoliosis is caused by poor posture, foundation anomalies and occupational strains. Compensatory scoliosis is a term used for non-structural scoliosis where compensation for pelvic imbalance is compensated for by a lumbar curvature to bring the
thoracic spine, and ultimately the head, back over the centre of the pelvis. These curves are not progressive but may become structural over time and are responsible for low back, hip and/or leg pain (Haldeman 1992). This type of scoliosis allows symmetrical lateral bending and only has segmental limitation in forward flexion during which the scoliotic curve disappears (Magee 2002). Curvatures correct on recumbent lateral-bending radiographic studies (Yochum and Rowe 1996; Cassella and Hall 1991). Non-structural scoliosis is correctable once the cause is determined (Magee 2002).

2.1.1 Classification and Types of Scoliosis

Structural Scoliosis:

1) Idiopathic Scoliosis:
   a) Infantile (0-3yrs) (Resolving or progressive types)
   b) Juvenile (3-10yrs)
   c) Adolescent (>10yrs) (Yochum and Rowe 1996; Cassella and Hall 1991; Lonner 2006).
2) Neuromuscular Scoliosis:
   a) Neuropathic (Upper motor neuron, lower motor neuron, dysautonomia or other causes)
   b) Myopathic (Arthrogryposis, muscular dystrophy, fibre type disproportion, congenital hypotonia, myotonia dystrophica or other causes).
3) Congenital Scoliosis:
   a) Failure of formation (Wedged vertebra or hemivertebra)
   b) Failure of segmentation (Unilateral or bilateral)
   c) Mixed.
4) Neurofibromatosis.
5) Mesenchymal disorders (Marfan’s, Ehlers-Danlos or others).
6) Rheumatoid disease.
7) Trauma (Fracture, surgical or irradiation).
8) Extrapspinal contractures (Postempyema or post burns).
9) Osteochondrodystrophies (Diastrophic dwarfism, mucopolysaccharidoses, spondyloepiphyseal dysplasia, multiple epiphyseal dysplasia or other causes).
10) Infection of bone (Acute or chronic).
11) Metabolic disorders (Rickets, osteogenesis imperfecta, homocystinuria or other causes).
12) Related to the lumbosacral joint (Spondylolysis and spondylolisthesis or congenital anomalies of the lumbosacral region).

13) Tumours (Of the vertebral column or spinal cord).

![Diagram](image)

**Fig 2.4** A) Diagrammatic representation of wedge-shaped vertebral bodies due to long term scoliosis; B) Radiograph showing wedging of vertebral bodies at apex of curve (Yochum and Rowe 1996).

**Non-structural Scoliosis:**

1) Postural
2) Hysterical
3) Nerve root irritation
   - a) Herniation of the nucleus pulposus
   - b) Tumours
4) Inflammatory (Example appendicitis)
5) Related to leg length discrepancy
6) Related to contractures about the hip. (Yochum and Rowe 1996)

As can be seen from the classification there are numerous aetiologies for scoliosis, however, idiopathic scoliosis constitutes 75% to 85% of all cases making it the most common type (Magee 2002; National Scoliosis Foundation 2005; Cassella and Hall 1991) and will, therefore, be discussed in more detail.
Idiopathic scoliosis is a structural lateral curvature of the spine with no known cause (Beers and Berkow 1999; Lehnert-Schroth 1992) and, is most commonly diagnosed between the ages of 8 and 10 years (Merenstein et al 1994). A right thoracic curve is the most common finding and any left thoracic curves should be suspected of being secondary to neurological or muscular disease (Merenstein et al 1994). Many hypotheses have been attributed to the cause, namely connective tissue disease, diet, enzymes, muscular imbalance and inheritance but no empirical evidence has yet been shown (Yochum and Rowe 1996).

The scoliosis causes rotation of the vertebral bodies into the convexity of the curve resulting in the spinous processes going toward the concavity (Yochum and Rowe 1996; Cassella and Hall 1991; Merenstein et al 1994). A fixed rotational prominence is seen on forward flexion when viewing the skyline of the back, often called a “razor back spine” (Yochum and Rowe 1996). The scoliotic curve is more prominent on forward flexion (Beers and Berkow 1999).

**Fig 2.5** A) Is a clinical photograph of a 20-month old boy with Infantile Idiopathic Scoliosis (SpineUniverse.com 2006). B) Is an illustration of how the rib hump is formed as a result of scoliosis (Yochum and Rowe 1996).

In the thoracic spine, vertebral rotation caused by idiopathic scoliosis results in posterior rib displacement on the convex side of the curve causing a rib hump, known as a thoracic gibbus deformity, with the ribs widely separated on that side. The concave side shows an anterior displacement of the ribs and they are close together. This may vary from mild to severe (Yochum and Rowe 1996: Magee 2002; Bickley and Hoekelman 1999; Lehnert-Schroth 1992).
Poor cosmetic appearance as well as musculoskeletal problems results from this (Magee 2002; Lehnert-Schroth 1992; Cassella and Hall 1991). However, pain is an uncommon complaint in adolescents with idiopathic scoliosis (Beers and Berkow 1999). Curvatures are at greatest risk of increasing during the growth spurt of adolescence (Lehnert-Schroth 1992; Lonner 2006). Lung and heart function may be considerably affected if the lateral curvature exceeds 60 degrees and low back pain is a likely symptom, making scoliosis a three-dimensional, complex disorder (Magee 2002; Lehnert-Schroth 1992; Dawson 2004; Merenstein et al 1994).

![Fig 2.6 Shows rapid progression of curvature in adolescent idiopathic scoliosis](SpineUniverse.com 2006).

Congenital scoliosis is not as common as idiopathic scoliosis but warrants a brief description as it is still a common form of scoliosis, making up 5% to 7% of cases (Merenstein et al 1994). Abnormal development of one or more vertebrae, the most common being hemi-vertebrae, is responsible for congenital scoliosis and is usually associated with other congenital anomalies. Aplasia or fusion of the ribs, small lung blood vessels, kidney anomalies and other spinal deformities often accompany congenital scoliosis (Jolly 1981). Associated diseases include Marfan’s syndrome, neurofibromatosis, cerebral palsy, muscular dystrophy and poliomyelitis (Merenstein et al 1994). The development of secondary curves and the presence of only one or two adjoining vertebrae being affected in this type of scoliosis actually improve the prognosis (Jolly 1981).

### 2.2 Clinical Screening of Scoliosis

History taking is important when assessing the patient clinically to determine possible congenital or neuromuscular aetiologies, as well as determining the severity of the scoliosis and associated symptoms.
Family history of scoliosis is important as certain types of scoliosis have a strong genetic influence (Lonner 2005; Dawson 2004). To avoid curve progression and spinal deformity early diagnosis and treatment are essential. Left untreated scoliosis may lead to serious complications and permanent spinal deformity (Dawson 2004). Range of motion of the spine should always be tested to determine any decrease in range of motion due to the scoliosis (Dawson 2004). On anterior observation of the patient, the arms should hang equidistant from the waist. In the presence of a scoliosis one arm hangs closer to the body than the other (Lonner 2005).

On posterior screening of the spine two fingers are run down either side of the spine until two red lines are formed making scoliosis easier to detect (Health24.com 2006). A more accurate screening method is to drop a plumb line so that a line is formed which should pass over the spinous process of the seventh cervical vertebra and into the gluteal cleft. This line is referred to as the posterior line of reference and divides the body into left and right halves posteriorly. Any deviation of the spine from this line of reference indicates lateral deviation or scoliosis of the spine (Magee 2002; Dawson 2004). Chiropractors used the plumb line as one of their first tools to analyze posture in the anterior, posterior and lateral positions. It provides a frame of reference for the line of action of the centres of gravity and shows up any postural deviation and asymmetry or alignment abnormalities (Haldeman 1992).

Fig 2.7 A) Shows the orientation of the posterior plumb line dividing the body into left and right halves; B) Shows an obvious scoliosis on posterior observation with increased space between left elbow and torso. Scoliosis is often more subtle and requires the use of a plumb line (SpineUniverse.com 2005).
Screening for scoliosis using Adams’ Sign will differentiate between a structural and non-structural scoliosis. The scoliosis will correct on forward flexion of the spine if the curve is non-structural, that is, functional in nature. This is a negative Adams’ Sign. A structural scoliosis is evident when the scoliosis does not correct on forward flexion and a rib hump deformity is noted in the event of a thoracic curvature (Schafer and Faye 1990; Lonner 2005; Dawson 2004; Merenstein et al 1994). The most important screening is that of the rib cage deformity (Haldeman 1992). This is regarded as a positive Adams’ Sign (Schafer and Faye 1990; Dawson 2004).

Posterior displacement of the ribs is directly related to the extent of rotation of the thoracic vertebra, which means that a greater degree of vertebral rotation will result in a larger rib displacement (Lehnert-Schroth 1992). The rib hump can be measured in degrees using a scoliometer (Dawson 2004; Schafer and Faye 1990). Adams’ Sign is sensitive to trunk deformity and is used as a confirmation of diagnosis of scoliosis with rib displacement. Screening of the spine using Adams’ Position is used in school screening programmes (Lonner 2005).

![Fig 2.8 Depicts the position in which screening for scoliosis using Adams’ sign is used. Notice the obvious posterior rib displacement (SpinUniverse.com 2005).](image)

Scoliosis may cause shoulder elevation on one side with anterior displacement of the shoulder. The normally rounded lateral aspect of the shoulder now appears flattened (Bickley and Hoekelman 1999; Lonner 2005; Dawson 2004). The spine is observed for hairy patches, sinuses and skin colour which may give clues to congenital anomalies (Lonner 2005).

Radiographic imaging of the spine is always done when a diagnosis of scoliosis has been made clinically to determine the type of scoliosis before a treatment plan can be determined (Yochum and Rowe 1996; Lonner 2006; Dawson 2004).
2.3 Treatment Options for Scoliosis

The selection of a treatment regime for the scoliosis patient is decided upon by considering all factors together. These include the possibility of curve progression, how the patient’s appearance will be affected and how the scoliosis will affect cardiopulmonary function. Other factors to consider are flexibility and family history (Yochum and Rowe 1996; Dawson 2005). Treatment is indicated for any curvature which shows progression on serial radiographs (Merenstein et al 1994). Patients should be instructed on correct postural behaviour, for example, alternating carrying arms or shoulders when carrying school bags or other heavy bags (Health24.com).

Types of therapy include the following: Close observation; bracing and surgery (Yochum and Rowe 1996; Lonner 2005). Use of plaster casting was done in the past but is only used for infantile idiopathic scoliosis and in countries where bracing is not available (Dawson 2005). For curves less than 20 degrees patients do not require bracing (Merenstein et al 1994) but should be closely monitored during the major growth period (10 to 15 years) for any increased deformity. This includes the use of radiographic studies every three months. An increase of more than 5 degrees or the appearance of a rib hump indicates the necessity for bracing. Exercise is helpful in improving posture, muscle tone, flexibility and proprioception but has not shown success in reducing the curvature (Yochum and Rowe 1996; Cassella and Hall 1991; Lonner 2005 and 2006). Chiropractic manipulation has proven helpful in decreasing musculoskeletal symptoms (Yochum and Rowe 1996).

![Fig 2.9 A) Photograph of a patient with adolescent idiopathic scoliosis before corrective surgery; B) The same patient post-surgery (SpineUniverse.com 2005).](image-url)
Chiropractic treatment of a lumbar scoliosis focuses on two aspects of the curvature, namely pain on the convex side and pain on the concave side of a lumbar spine scoliosis. Most commonly a lateral flexion-rotation occurs which accounts for the antalgic posture, caused primarily by contraction of the quadratus lumborum muscles. The lumbar rotation toward the concave side is the most important because the articulation on this side still has partial mobility. Movement on the convex side is limited by muscle hypertonicity. The most successful adjustment is a “roll” with the patient lying on the concave side (Schafer and Faye 1990).

Patients being treated at the Katharina Schroth Spinal Deformities Centre in Germany range in age from 8 to 70 years. Of these patients 80% to 90% have idiopathic scoliosis and can only be treated symptomatically at this centre. Scoliosis is treated at the Spinal Deformities Centre by using physiotherapy methods devised by Katharina Schroth. These methods include postural awareness techniques, orthopaedic exercises and rotational breathing which have shown to improve the cosmetic appearance, pulmonary function and pain of patients attending this centre (Lehnert-Schroth 1992).

Lateral electrical surface stimulation involves stimulation of the erector spinae muscles on the convex side of the primary curve. Results of this treatment in recent years have not been successful (Cassella and Hall 1991).

Fig 2.10 A) Patient consultation for treatment of scoliosis; B) Male patient with adolescent idiopathic scoliosis wearing a brace (SpineUniverse.com 2006).
Bracing of a scoliosis patient is indicated when curves are between 20 and 40 degrees in the skeletally immature spine which is still flexible and the curve is progressive (Yochum and Rowe 1996; Lonner 2005; Dawson 2005; Merenstein et al 1994). This is still the most popular method of non-operative treatment and is mostly used for adolescent idiopathic scoliosis as standard practice (Dawson 2005; Heese 1995). Radiographic studies should be performed every 3 to 4 months until the patient is skeletally mature and then gradually weaned off the brace. Annual examination for 5 years is then recommended to pre-empt any regression (Yochum and Rowe 1996; Cassella and Hall 1991; Lonner 2005).

The type of brace worn and amount of time spent in the brace is variable and patient specific. Removal of the brace during sport is a necessity and an alternative to full-time bracing is a nighttime bending brace for management of single curves. Bracing is designed to stop curve progression and any curve correction is considered an advantageous side effect (Lonner 2005; Dawson 2005). Curvatures greater than 40 degrees and high thoracic curves are not suitable for bracing and may require surgical intervention (Dawson 2005).

Treatment of adolescent idiopathic scoliosis is dependent on physiological maturity, not age, curve magnitude and potential for progression. Thoracic curves have a greater chance of progression and those of significant magnitude before the growth spurt of adolescence are of great concern (Lonner 2005).
Indications for surgery are as follows: Structural abnormalities responsible for the scoliosis which can be surgically corrected; rapidly progressing curvatures in an immature spine, or if the curvature exceeds 40 degrees; and occasionally for mild deformities for cosmetic reasons (Yochum and Rowe 1996; Cassella and Hall 1991; Lonner 2005 and 2006; Dawson 2005; Merenstein et al 1994). Cosmetic reasons for surgical correction of scoliosis account for the majority of patients seeking corrective surgery but do not promise great success (Berven 2006). Failure of non-operative treatment may require surgical intervention (Cassella and Hall 1991; Lonner 2006 and 2005; Dawson 2005) but is case specific.

Surgical intervention in adults is more complex and includes criteria such as increasing respiratory difficulties, late progression and intractable pain. These criteria, however, are not definitive (Yochum and Rowe 1996; Cassella and Hall 1991). Surgery has not been able to improve the rib hump caused by structural scoliosis and physiotherapy is required to maintain the surgical results (Lehnert-Schroth 1992).

Paralytic Scoliosis, a complication of cerebral palsy, poliomyelitis and myelomeningocele, is treated by means of bracing or fusion. Congenital scoliosis is treated by early fusion to prevent progression. Scoliosis as a result of neurofibromatosis is treated by fusion (Heese 1995). Non-structural scoliosis is treated by treating the underlying cause (Merenstein et al 1994).
The most successful approach appears to be a team approach including an orthopaedic surgeon to assess radiographic findings, an orthotist to design the bracing system for the patient and a physical therapist to address muscular dysfunction (Cassella and Hall 1991). Chiropractic care has its place here to address joint dysfunction (Schafer and Faye 1990).

The prognosis for curvatures less than 20 degrees that show no progression is good with very little cosmetic disruption. Patients should be informed of genetic transmission of scoliosis to their children. Thoracic curvatures greater than 60 degrees are associated with a shortened life span. Large lumbar curvatures lead to vertebral subluxation, early arthritic degeneration of the spine and debilitating low back pain. Early diagnosis and treatment improve the prognosis tremendously, often avoiding surgical intervention. For this reason, school screening programmes have gained popular support in the United States (Merenstein et al 1994). South Africa, however, has not continued this practice.

A scoliosis brace is usually worn under clothing and is one method used to try to improve the exaggerated curvature of the spine as seen in scoliosis

Fig 2.13 Shows a more customized form of bracing (SpineUniverse.com 2006).

### 2.4 Statistics of Scoliosis

All age groups and races, regardless of socio-economic status are affected by scoliosis (National Scoliosis Foundation 2005). The primary age of onset is 10 to 15 years of age occurring equally in males and females. Females are, however, 8 times more likely to develop curve magnitudes that require treatment (National Scoliosis Foundation 2005).
Patients attending the Katharina Schroth Spinal Deformities Centre in Germany have a female to male ratio of 7:1 (Lehnert-Schroth 1992). Scoliosis affects 2-3% of the population in the United States (National Scoliosis Foundation 2005). Worldwide prevalence of the disease makes up 1% of the population, including all forms of the disease (Dawson 2005). A prevalence of 2% to 4% for curves greater than 10 degrees is reported; and 1 to 3 children out of a thousand have structural curves greater than 20 degrees. Female to male ratio appears to change as curve magnitude increases. As curve magnitude increases so does female incidence, but male incidence remains relatively constant (Cassella and Hall 1991; Lonner 2006).

Of all the cases of scoliosis seen by physicians, 85% are classified as idiopathic (National Scoliosis Foundation 2005). Idiopathic scoliosis accounts for 75% to 85% of all cases of structural scoliosis (Magee 2002; Lehnert-Schroth 1992). Sixty to 80% of cases of idiopathic scoliosis occur in girls and 2 to 3% of children aged 10 to 16 years have detectable idiopathic scoliosis (Beers and Berkow 1999; Heese 1995; Merenstein et al 1994). Inherited genetic influence accounts for up to 30% of patients having another family member with idiopathic scoliosis, implying a strong genetic influence for this type of scoliosis, however, the mechanism of development remains unknown (Yochum and Rowe 1996; Cassella and Hall 1991; Merenstein et al 1994).

Infantile idiopathic scoliosis (0-3 years of age) is usually of the resolving type but a small percentage is progressive, is slightly more common in males and is usually a left convex thoracic curve (Yochum and Rowe 1996; Lonner 2006; Jolly 1981; Merenstein et al 1994).
This type of scoliosis is often associated with plagiocephaly and rib cage moulding (Jolly 1981). Juvenile idiopathic scoliosis (3-10 years of age) is more common in females (4 to 1) and as many as 30% will have corrective surgery (Yochum and Rowe 1996; Lonner 2006).

Adolescent idiopathic scoliosis (10 years to skeletal maturity) is the most common type of idiopathic scoliosis accounting for approximately 65% of adolescents with scoliosis (Cassella and Hall 1991) and a female predominance of 9 to 1. According to the Scoliosis Research Society, adolescent idiopathic scoliosis accounts for approximately 80% of this type of scoliosis (Lonner 2006). An increased incidence of pes cavus coexists with this type of scoliosis and the critical time frame for progression is between the ages of 12 and 16 years. Further progression is unlikely once skeletal maturity has been reached (Yochum and Rowe 1996). The greater the curve the more likely it is to progress after skeletal maturity.

Less than 10% of cases of idiopathic scoliosis require active treatment. The most common curve pattern is a right convex thoracic type with a left convex lumbar curve (Beers and Berkow 1999; Merenstein et al 1994). In later life degenerative changes may result in an increase of approximately 15 degrees in the curvature. Cardiac and pulmonary function becomes impeded when thoracic curves reach a magnitude of 70 degrees and may pose a threat to life (Lonner 2006; Merenstein et al 1994). Congenital heart disease is 10 times more likely when the curve is greater than 20 degrees in the thoracic spine. Congestive heart failure is the most common direct cause of death in people with scoliosis (Yochum and Rowe 1996).

The above classifications of idiopathic scoliosis indicate the age at which the curvature is diagnosed and does not necessarily determine the age of onset (Cassella and Hall 1991).
Approximately 25% of all scoliotic curves will be progressive. Those at highest risk of progression are double primary curves (two curves in one region) and primary lumbar curves with compensatory thoracic curves. Curves greater than 20 degrees are three times more likely to progress. Spinal fusions for scoliosis below the L2 level have a higher incidence of disc related pathologies requiring possible surgery later on in life (Yochum and Rowe 1996).

Fig 2.16 A) Posterior and B) Anterior view of a three-dimensional projection of an MRI showing the degenerative changes caused by long term idiopathic scoliosis (SpineUniverse.com 2006).

Scoliosis is often detected by parents and by paediatricians during routine physical examinations. The majority of cases of scoliosis are detected in school screening programs. Screening programs began in the 1940’s and are still widely used as mandatory procedures in the United States, Canada and other countries. These screenings are conducted on children aged 10 to 16 years of age because this is the group at highest risk for adolescent idiopathic scoliosis. These screening programs make use of the plumb line and Adams’ position screening methods. School screening programmes have yielded a vast amount of information regarding the natural history and prediction of prevalence of scoliosis in these countries (Cassella and Hall 1991).

As discussed in chapter 1, no studies have been found for the incidence of scoliosis in South Africa and no information regarding South African statistics for scoliosis has been found. Health24.com, a South African based web site use American statistics for scoliosis. The only statistics for scoliosis in South Africa that could be found were from CureResearch.com (2005).
An incidence of scoliosis of 133,345 people out of a population of 44,448,470 is given by CureResearch.com which is merely an extrapolation based on the incidence of scoliosis in other countries. Literature found on scoliosis studies done in South Africa use statistics from other countries for the incidence of scoliosis. This necessitates the study into South African incidence of scoliosis.

2.5 School Health Programs in South Africa

In 2003 Dr. Manto Tshabalala-Msimang (Minister of Health) and the Department of Health drafted a school health policy for South Africa. In brief, this policy addresses the following health issues at school level: Poverty and environmental issues including adequate sanitation. Nutritional status of children. Sexual activity, HIV and AIDS, and reproductive health. Trauma, violence and mental health. Substance abuse and risk-taking behaviour. Hearing, vision and speech impairment. Health education.

No specific mention is made as to the screening of children for other developmental disorders, including scoliosis. This area is addressed vaguely by incorporating a support structure for school nurses and health teams. It is not clear whether screening for scoliosis is a service offered by the school health policy. Implementation of the school health policy began in 2003 and is supposed to be completely implemented by 2007 in all government schools (Department of Health 2003). During the course of this trial it was discovered that children at primary school level had never been screened for scoliosis at the school.

2.6 Classification of Race Groups in South Africa

The reclassification of race groups in South Africa took place in 1998 under the amended employment equity act of this year to define “black people” as a generic term which means Africans, Coloureds and Indians. The reason for this reclassification was to group all previously disadvantaged people under a single title (Amended Employment Equity Act 1998; Government Gazette 2004). The significance of inclusion of this information into this thesis is that a comparison is drawn between previously disadvantaged and advantaged groups.
CHAPTER THREE

METHODOLOGY
3.1 Introduction

In this chapter an explanation and description of the way in which this study was conducted is given.

3.2 Study Design

A total number of 32 primary schools in the Metropolis of Johannesburg were used in this study. Of the 32 primary schools used 16 of them were government schools and 16 were independent schools. Primary schools from the north, south, east and west, were randomly selected, 8 from each region (4 government and 4 independent). Using Adams’ Position and the Erect Position for screening the participants in this study for scoliosis, data was collected as to how many children tested positive for scoliosis. In addition, their gender, race and nature of the primary school they attended were recorded. Also noted was whether either of the tests for scoliosis was positive.

3.3 Sample Group

From the primary schools described above a grade 5 class from each school was randomly selected for screening. Children from all race groups and both genders were included.

3.4 Informed Consent

Participants in this study were children aged 10 to 11 years old and therefore required consent from their parents or guardians to participate. An information letter describing the procedures involved in the screening as well as informed consent was sent to the parents of the children participating in this study (appendix B). A similar letter was given to the principal of each primary school requiring their informed consent (appendix A). No screenings took place without the signed consent of each of the participant’s parents and that of the involved primary school’s principal. Any child whose parents or guardian denied consent was not included in the study. Primary schools where consent by the principal was denied were also not involved in this study.
3.5 Inclusion Criteria

Participants in this study were included if they were aged 10 to 11 years old, attended a selected primary school and had signed parental or guardian consent.

3.6 Exclusion Criteria

Participants not aged 10 to 11 years and who did not have signed consent, or where the principal of the primary school denied consent, were excluded from the trial.

3.7 Sample Size

Sample size was determined by the number of children in a class at each of the involved primary schools. Independent primary schools generally had fewer children attending their schools than government schools and had, therefore, fewer children per class. Hence, a total number of 320 children were screened from the 16 independent schools, whereas a total number of 374 children were screened from the 16 government schools.

3.8 Procedure

Participants at each of the primary schools were screened in the Erect Position using a vertical plumb line. Suspending a piece of string from a frame with a weight tied to the bottom to get a true vertical line using the force of gravity created this. This method of screening detects spinal deviations at any level if the plumb line is taken from the occipital protuberance to the gluteal cleft. In all cases participants were required to stand with their bare backs in front of the plumb line so that any deviation of the spine from the midline could be detected. Participants were also required to wear short pants, or skirts in the case of female participants, and remove their shoes so as not to affect leg length and to make sure the knees were not bent and participants were standing upright. Male participants were required to remove their shirts and female participants wore swimming costumes so that they were adequately exposed for the screening.
Fig 3.1 Demonstrates correct postural alignment of the spine (Magee 2002).

Fig 3.2 Demonstration of how a plumb line obviates scoliosis. In patients with a less pronounced scoliosis this method makes screening more accurate (Magee 2002).
A second screening test using Adams’ Position was then used. This required the participants to flex forward from the waist so that the skyline of the back could be observed. In this position a rib hump would become evident. A rib hump is caused by a thoracic scoliosis where vertebral rotation due to scoliosis elevates the rib cage on one side and depresses it on the other side. Deviation of the spine from the midline may be visible in this method of screening but is subjective. The Erect Position with plumb line for screening lateral spinal deviation is more accurate. Adams’ Position is used primarily for screening of vertebral rotation in the thoracic spine with resultant rib elevation and depression respectively.

Fig 3.3 Demonstration of how Adams’ Position clearly demonstrates a rib hump and rib hollow (Magee 2002).

A positive test in the Erect Position for scoliosis combined with a positive test in Adams’ Position for a rib hump would determine a diagnosis of scoliosis with associated vertebral rotation of the thoracic spine and resultant rib involvement. Vertebral rotation of the lumbar spine due to scoliosis can only be diagnosed from radiographic studies. A clinical diagnosis of scoliosis should always be confirmed by radiographic studies to determine the type of scoliosis.

Data collected included the participant’s name, age, race, primary school, type of primary school (government or independent), and results of the screening tests (positive or negative). A positive result for Adams’ Position always has a positive result for the Erect Position but a positive test in
the Erect Position does not necessarily give a positive test for Adams’ Position due to the various types of scoliotic curvatures, therefore, if either of the tests were positive a diagnosis of scoliosis was made.

Parents of participants diagnosed with scoliosis were contacted to inform them of this diagnosis so that further intervention could be pursued.

### 3.9 Data Analysis

A statistician at Statcon evaluated data collected in the trial statistically. Results were primarily obtained using Fisher’s Exact Test in the Chi-Square Tests and Phi values in the Symmetric Measures. The results of this evaluation are discussed in later chapters where statistical comparisons and conclusions are drawn.

*Fig 3.4 This patient has marked idiopathic scoliosis (Magee 2002).*
CHAPTER FOUR

RESULTS
4.1 Introduction

In this chapter the results obtained from the trial of determining the incidence of scoliosis amongst primary school children in the metropolis of Johannesburg are discussed in detail. Graphical representations of the comparisons drawn between race, gender and type of primary school are shown. The use of tables depicts statistical information acquired from the trial.

4.2 Demographics

Participants for this study were taken from the four primary compass directions, namely north, south east and west. From these four regions participants were taken from both government and independent primary schools to be able to make socio-economic comparisons. Eight primary schools, four government and four independent, from each region were used to sample participants from. Participants included all race groups, both male and female aged 10 to 11 years.

Table 4.2.1 Number of Participants from Independent and Government Schools

<table>
<thead>
<tr>
<th>Type of School</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent Schools</td>
<td>320</td>
<td>46.1</td>
</tr>
<tr>
<td>Government Schools</td>
<td>374</td>
<td>53.9</td>
</tr>
<tr>
<td>Total</td>
<td>694</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.2.1 depicts the number of participants obtained from each of the types of primary schools and the percentage these schools made up. Independent primary school children screened totalled 320, constituting 46.1% of the total number of children. The lower percentage of independent school children is accounted for by the fact that fewer children attend independent schools due to the higher cost of tuition fees at these schools. Government primary school children totalled 374, constituting 53.9% of the total number of children. A total of 694 children were screened in this study.
Table 4.2.2 Number of Children in Each Age Group

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>300</td>
<td>43.2</td>
</tr>
<tr>
<td>11</td>
<td>394</td>
<td>56.8</td>
</tr>
<tr>
<td>Total</td>
<td>694</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.2.2 shows the number of children from each age group. These figures are of interest only and have no statistical value in the results.

Table 4.2.3 Number of Children in Each Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>332</td>
<td>47.8</td>
</tr>
<tr>
<td>Male</td>
<td>362</td>
<td>52.2</td>
</tr>
<tr>
<td>Total</td>
<td>694</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.2.3 shows the number of children from each gender. An attempt to have an equal number of boys and girls was made but was not entirely possible as it was determined by the ratio of boys to girls in each individual school as well as parental consent. The percentages are, however, close enough for the study to be statistically correct.
Table 4.2.4 Number of Children from Each Race Group

<table>
<thead>
<tr>
<th>Race</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASIAN</td>
<td>6</td>
<td>0.9</td>
</tr>
<tr>
<td>BLACK</td>
<td>243</td>
<td>35.0</td>
</tr>
<tr>
<td>COLOURED</td>
<td>30</td>
<td>4.3</td>
</tr>
<tr>
<td>INDIAN</td>
<td>52</td>
<td>7.5</td>
</tr>
<tr>
<td>WHITE</td>
<td>363</td>
<td>52.3</td>
</tr>
<tr>
<td>Total</td>
<td>694</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.2.4 shows the number of children from each race group and their percentages. In the following table is a representation of these race groups as revised by the employment equity act of 1998 where only two race groups are recognised, namely Black and White. Race groups previously classified as Black, Coloured and Indian are now collectively classified as Black. Race groups previously classified as White and Asian are now collectively classified as White.

Table 4.2.5 Number of Children from Revised Race Groups

<table>
<thead>
<tr>
<th>(RR) Race</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLACK (OFFICIAL)</td>
<td>331</td>
<td>47.7</td>
</tr>
<tr>
<td>WHITE (OFFICIAL)</td>
<td>363</td>
<td>52.3</td>
</tr>
<tr>
<td>Total</td>
<td>694</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.2.5 represents the number of children in each of the revised race groups, as discussed above, with the relevant percentages in each group.
4.3 Scoliosis Screening Results

The results of the trial are divided into the following categories:

a) Total number of children testing positive and negative in the Adams’ Position;
b) Total number of children testing positive and negative in the Erect Position;
c) Comparison of Government and Independent schools for Adams’ Position;
d) Comparison of Government and Independent schools for Erect Position;
e) Comparison of each gender for Adams’ Position;
f) Comparison of each gender for the Erect Position;
g) Comparison of each race group for Adams’ Position;
h) Comparison of each race group for the Erect Position.

Table 4.3.1 Results of Screening in Adams’ Position [(a)]

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>684</td>
<td>98.6</td>
</tr>
<tr>
<td>Positive</td>
<td>10</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>694</td>
<td>100.0</td>
</tr>
</tbody>
</table>

This table shows that 1.4% of all the participants in this trial had a positive result for the Adams’ Position screening test.
Table 4.3.2 Results of Screening in Erect Position [(b)]

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>637</td>
<td>91.8</td>
</tr>
<tr>
<td>Positive</td>
<td>57</td>
<td>8.2</td>
</tr>
<tr>
<td>Total</td>
<td>694</td>
<td>100.0</td>
</tr>
</tbody>
</table>

This table shows that 8.2% of all participants in this trial had a positive result for the Erect Position screening test, bearing in mind that all participants screening positive in Adams’ Position will screen positive in the Erect Position but not all participants screening positive in the Erect Position will screen positive in Adams’ Position. This means that Erect Position screening covers all types of scoliosis and the results are indicative of the total number of participants diagnosed with scoliosis in this trial. Adams’ Position screening is used for determining the number of children where scoliosis has affected the rib cage by causing vertebral rotation in the thoracic spine. Table 4.3.1 shows that far fewer children have this condition which implies that most children diagnosed with scoliosis in this trial have a mild form thereof.
Table 4.3.3 Comparison of Government and Independent schools for Adams’ Position [(c)]

<table>
<thead>
<tr>
<th></th>
<th>Adams Position for Scoliosis Screening</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td><strong>Independent Schools</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>312</td>
<td>8</td>
</tr>
<tr>
<td>% within Group (New)</td>
<td>97.5%</td>
<td>2.5%</td>
</tr>
<tr>
<td><strong>Government Schools</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>372</td>
<td>2</td>
</tr>
<tr>
<td>% within Group (New)</td>
<td>99.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>684</td>
<td>10</td>
</tr>
<tr>
<td>% within Group (New)</td>
<td>98.6%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

From this table a significant difference between Government and Independent schools is seen in the Adams’ Position screening test ($p=0.05$ showing 95% accuracy). Independent primary schools have a greater incidence of scoliosis which affects the thoracic spine (2.5%) than Government primary schools (0.5%).
Table 4.3.4 Comparison of Government and Independent schools for Erect Position [(d)]

<table>
<thead>
<tr>
<th></th>
<th>Erect Position for Scoliosis Screening</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td><strong>Independent Schools</strong></td>
<td>286</td>
<td>34</td>
</tr>
<tr>
<td>Count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% within Group (New)</td>
<td>89.4%</td>
<td>10.6%</td>
</tr>
<tr>
<td><strong>Government Schools</strong></td>
<td>351</td>
<td>23</td>
</tr>
<tr>
<td>Count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% within Group (New)</td>
<td>93.9%</td>
<td>6.1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>637</td>
<td>57</td>
</tr>
<tr>
<td>Count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% within Group (New)</td>
<td>91.8%</td>
<td>8.2%</td>
</tr>
</tbody>
</table>

From this table a significant difference between Government and Independent schools is seen in the Erect Position screening test ($p=0.037$ showing 96.3% accuracy). Independent primary schools have a higher incidence of scoliosis (10.6%) than Government primary schools (6.1%).
Table 4.3.5 Comparison of Each Gender for Adams’ Position [(e)]

<table>
<thead>
<tr>
<th>Gender</th>
<th>Adams Position for Scoliosis Screening</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>327</td>
<td>5</td>
</tr>
<tr>
<td>% within Gender</td>
<td>98.5%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>357</td>
<td>5</td>
</tr>
<tr>
<td>% within Gender</td>
<td>98.6%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>684</td>
<td>10</td>
</tr>
<tr>
<td>% within Gender</td>
<td>98.6%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

Table 4.3.5 shows an almost equal distribution of males and females testing positive for scoliosis in Adams’ Position. The difference between them is too small to be of statistical significance \((p=1.000\) showing a 0% accuracy).
Table 4.3.6 Comparison of Each Gender for the Erect Position [(f)]

<table>
<thead>
<tr>
<th>Gender</th>
<th>Count</th>
<th>Negative</th>
<th>Positive</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>302</td>
<td>91.0%</td>
<td>9.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Male</td>
<td>335</td>
<td>92.5%</td>
<td>7.5%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>637</td>
<td>91.8%</td>
<td>8.2%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 4.3.6 shows the comparison of male and female participants in the Erect Position screening. There is a 9.0% incidence of scoliosis in females and a 7.5% incidence in males. The difference is not large enough to be a statistically significant difference ($p=0.490$ and needs to be less than 0.050 to be significant). What this does mean, however, is that the incidence in males is almost equivalent to that of females. In the past the incidence was far higher in females, making this finding of great significance to this study.
Table 4.3.7 Comparison of Each Race Group for Adams’ Position [(g)]

<table>
<thead>
<tr>
<th>Race (R)</th>
<th>Count</th>
<th>Adams Position for Scoliosis Screening</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>BLACK</td>
<td>241</td>
<td>2</td>
<td>243</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>99.2%</td>
<td>0.8%</td>
<td>100.0%</td>
</tr>
<tr>
<td>COLOURED</td>
<td>29</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>96.7%</td>
<td>3.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>INDIAN/ASIAN</td>
<td>58</td>
<td>0</td>
<td>58</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>100.0%</td>
<td>0.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>WHITE</td>
<td>356</td>
<td>7</td>
<td>363</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>98.1%</td>
<td>1.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>684</td>
<td>10</td>
<td>694</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>98.6%</td>
<td>1.4%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 4.3.7 shows the comparison of incidence amongst the different race groups for the Adams’ Position screening test. From this table an interesting difference is seen between race groups with coloureds having the highest incidence at 3.3% (statistical significance of this table has a phi value of 0.064). The differences are, however, not large enough to be of statistical significance. A table depicting the revised race group is shown in table 4.3.8.
Table 4.3.8 Comparison of Each Race Group for the Adams’ Position
(Revised Race Groups)

<table>
<thead>
<tr>
<th>Race</th>
<th>Count</th>
<th>Adams Position for Scoliosis Screening</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>BLACK (OFFICIAL)</td>
<td>328</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>% within (RR) Race</td>
<td>99.1%</td>
<td>0.9%</td>
<td></td>
</tr>
<tr>
<td>WHITE (OFFICIAL)</td>
<td>356</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>% within (RR) Race</td>
<td>98.1%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>684</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>% within (RR) Race</td>
<td>98.6%</td>
<td>1.4%</td>
<td></td>
</tr>
</tbody>
</table>

This table shows a slight difference between White and Black race groups, with 0.9% incidence in Blacks and 1.9% incidence in Whites, which is not large enough to be of statistical significance ($p=0.345$ where $p$ must be less than 0.050 to be significant). This means that incidence is statistically equivalent between the two race groups.
Table 4.3.9 Comparison of Each Race Group for the Erect Position [(h)]

<table>
<thead>
<tr>
<th>Race</th>
<th>Count</th>
<th>Erect Position for Scoliosis Screening</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>BLACK</td>
<td>233</td>
<td>10</td>
<td>243</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>95.9%</td>
<td>4.1%</td>
<td>100.0%</td>
</tr>
<tr>
<td>COLOURED</td>
<td>27</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>90.0%</td>
<td>10.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>INDIAN/ASIAN</td>
<td>55</td>
<td>3</td>
<td>58</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>94.8%</td>
<td>5.2%</td>
<td>100.0%</td>
</tr>
<tr>
<td>WHITE</td>
<td>322</td>
<td>41</td>
<td>363</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>88.7%</td>
<td>11.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>637</td>
<td>57</td>
<td>694</td>
</tr>
<tr>
<td>% within (R) Race</td>
<td>91.8%</td>
<td>8.2%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 4.3.9 has more significant differences for the individual race groups screened in the Erect Position. This result shows whites to have the highest incidence at 11.3% and Blacks the lowest incidence at 4.1% (\(\phi\) value is 0.125).
Table 4.3.10 Comparison of Each Race Group for the Erect Position (Revised Race Groups)

<table>
<thead>
<tr>
<th>(RR) Race</th>
<th>BLACK (OFFICIAL)</th>
<th>WHITE (OFFICIAL)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>Count</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td>315</td>
<td>322</td>
<td>637</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>41</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>331</td>
<td>363</td>
<td>694</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td>% within (RR) Race</td>
<td>95.2%</td>
<td>88.7%</td>
<td>91.8%</td>
</tr>
<tr>
<td>% within (RR) Race</td>
<td>4.8%</td>
<td>11.3%</td>
<td>8.2%</td>
</tr>
</tbody>
</table>

Table 4.3.10 shows statistically significant differences between the two race groups with Whites at 11.3% and Blacks at 4.8% ($p=0.002$). A representation of this table is shown in a graph on the next page.

A full discussion of the results of this chapter is found in chapter five with chapter six drawing conclusions and discussing recommendations regarding this field of study.
Graph 4.3.1 is a representation of the comparison between independent and government schools.
Graph 4.3.2 is a representation of the comparison between genders.
Graph 4.3.3 is a representation of the comparison between revised race groups.
5.1 Introduction

In this chapter the statistical results obtained from objective data in chapter four will be discussed. Specific attention is given to the comparative differences between certain groups and the ultimate incidence of scoliosis in primary school children in the metropolis of Johannesburg.

Comparison is made between government and independent primary schools; between male and female children; and between race groups. The comparison between race groups is divided into two sections, that is, comparison between all race groups and comparison between the revised race groups as defined by the Amended Employment Equity Act of 1998. The comparison of revised race groups draws comparison between previously disadvantaged and privileged groups more than it compares race groups.

Effect size was incorporated into the statistical analysis which serves to provide the researcher with information on statistical significance. Effect size is grouped into four categories, namely, no effect (0.0 – 0.1), small effect (0.1 – 0.3), medium effect (0.3 – 0.5) and large effect (0.5 – 1.0). Statistical significance is obtained when the effect size is 0.5 or more.

5.2 Demographics

A total of 694 primary school children aged 10 to 11 years were screened for scoliosis in this research trial. A total number of 32 primary schools were visited, 16 government and 16 independent primary schools, to acquire the total number of children screened. The selection of schools was made from the four primary compass directions, namely north, south, east and west, taking eight primary schools from each. This included four government and four independent primary schools from each direction chosen randomly from a list of primary schools obtained from the Department of Education. A single grade five class was chosen randomly from each primary school, including males and females and all race groups, for the trial, thereby insuring random sampling. Not all children from the selected grade five classes could be screened because of denied consent by some of their parents, however, a large enough group was still acquired.
5.3 Comparison of Government and Independent Primary Schools

Of the 32 primary schools involved in this study, 16 were government schools and 16 were independent schools. A total of 320 children were screened at the independent schools and a total of 374 children were screened at the government schools.

The comparison of government and independent schools is more a comparison of lower to middle class income groups (government schools) and upper income groups (independent schools). Spinal screening in the Erect Position with a plumb line found that 10.6% of the children screened at the independent schools were positive for scoliosis. Only 6.1% of the children screened at government schools were positive for scoliosis. The difference between these two groups is of statistical significance ($p=0.037$).

Adams’ Position screening found that 2.5% of the children at independent schools were positive for this test, whereas only 0.5% of the children at government schools were found to have a positive test. It is important to remember that all children testing positive in the Adams’ Position would have tested positive in the Erect Position with plumb line. Adams’ Position is a test used to diagnose rib displacement due to structural scoliosis specifically and, therefore, gives an incidence for this type of scoliosis. Again, a marked difference between the two groups is seen with government schools having a lower incidence to independent schools. The difference is, again, statistically significant ($p=0.050$).

There appears to be a significant influence by economic status on the prevalence of scoliosis. The reason for this may be due to lower physical activity by children from upper income groups due to the availability of computers, internet, DSTV, and computer and television games like Play Station. Lower to middle income groups might not have these luxuries and the children may, therefore, be more involved in school sports and outdoor activities as a source of entertainment. If this is so, postural reasons for the development of scoliosis would be a primary aetiology.
5.4 Comparison of Male and Female Participants

The total number of female participants in this study was 332 and the total number of male participants in this study was 362. All participants were between the ages of 10 and 11 years. An attempt was made to get an equal number of male and female children for the study but was not logistically possible. The difference, however, between the number of males and females is small enough to have no statistical significance.

Spinal screening in the Erect Position found 9.0% of the female participants to have a positive result and 7.5% of the male participants were positive. This is close enough to have an insignificant statistical difference between the two groups. Even though there is no statistical difference between males and females the result is important because it shows an equal incidence of scoliosis in males and females ($p=0.490$).

Screening for scoliosis in the Adams’ Position showed that 1.5% of the female participants had a positive result and 1.4% of male participants were positive ($p=1.000$). Statistically there is no difference between the two groups which is congruent with the results of the Erect Position. Adolescent Idiopathic Scoliosis, the primary form of structural scoliosis has a higher incidence in females than in males; in fact up to 80% of cases are females (Beers and Berkow 1999; Heese 1995; Merenstein et al 1994). The results of this study, however, show an equal distribution indicating an increase in males. A possible reason for this is, again, decreased physical activity levels by boys due to the reasons discussed above.

5.5 Comparison of Race Groups

For the purposes of this study, only the revised race groups will be used for discussion in their comparison. This is to draw comparison, more between previously disadvantaged and privileged groups, than between racial groups as such. Statistical differences between individual race groups showed slight differences but were too small to have statistical significance. The individual quantities are as follows: Asians made up 0.9%; Blacks made up 35.0%; Coloureds made up 4.3%; Indians made up 7.5%; and Whites made up 52.3%. Differences between the revised race groups, however, were of great significance and interest. Blacks now comprise 47.7% and Whites 52.3% of the total.
Results for spinal screening in the Erect Position for the revised race groups showed that 4.8% of Black children had a positive result whereas 11.3% of White children were positive. The difference between these two groups is marked and is of statistical significance and great interest \((p=0.002)\). This is virtually a confirmation that socio-economic status has a definite influence in the incidence of scoliosis. Reasons discussed before as to why this occurs deserve serious consideration.

Screening for scoliosis in Adams’ Position found that 0.9% of Black children were positive for this test and 1.9% of White children were positive \((p=0.345)\). This result is very interesting because it shows a statistically equivalent incidence for scoliosis with posterior rib displacement in the two groups. The possibility is raised that idiopathic scoliosis is not influenced by socio-economic status. However, in the previous two comparisons a strong influence is suggested.

### 5.6 Summary

In summary, 8.2% of the children screened were diagnosed with scoliosis and 1.4% of these children had rib involvement due to a structural scoliosis confirmed by the Adams’ Position test. Idiopathic scoliosis was not tested for specifically because this requires the use of radiographic studies which would work out very expensive and time consuming on such a large scale. There is a definite trend to the results of this trial and further investigation into the influence of physical activity on scoliosis is required.
CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS
6.1 Conclusion

The original objective of this study was to compare the current incidence of scoliosis in South Africa to past incidence studies to determine if there had been an increase or decrease in numbers. Unfortunately no historical studies into the incidence of scoliosis in South Africa could be found. It was also not logistically viable to do a study for the whole of South Africa. This study, therefore, serves to compare the incidence of scoliosis to that of other countries and world statistics. It covers only the metropolis of Johannesburg due to time and financial constraints.

The United States of America has a national incidence of 2% to 3% of the population for scoliosis, including all forms of the disease (National Scoliosis Foundation 2005). Worldwide prevalence is at 1% of the population for all forms of scoliosis (Dawson 2005). This study found that 8.2% out of 694 children screened in the Erect Position were diagnosed positive for scoliosis.

Screening for scoliosis in the Erect Position detects all forms of scoliosis which is why it was the method of choice for this study. This means that the incidence of scoliosis, including all forms of the disease, for children in Johannesburg primary schools is far greater than that for the United States and the rest of the world.

Adams’ Position is a method of screening that detects rib displacement due to structural scoliosis (Schafer and Faye 1990; Lonner 2005; Dawson 2004; Merenstein et al 1994). It is not, however, the definitive diagnostic tool for idiopathic or other types of structural scoliosis which require radiographic confirmation. It is merely a confirmation of thoracic involvement of structural scoliosis. If most cases of adolescent idiopathic scoliosis have a thoracic curvature with posterior rib displacement (Beers and Berkow 1999; Merenstein et al 1994), then an incidence of 1.4% in Johannesburg is lower than that of the United States at 2% to 3% (Beers and Berkow 1999; Heese 1995; Merenstein et al 1994).

This study has shown a higher incidence of scoliosis as a whole across all groups involved. A marked higher incidence was discovered in children from independent primary schools and White (privileged) children. As discussed in chapter 5, there is a strong indication towards socio-economic status having an effect on the incidence of scoliosis. Further investigation into this area is required to draw objective conclusions.
6.2 Recommendations

Recommendations which may have assisted in improving this study or future studies covering this topic are listed below:

Investigation into the influence of socio-economic status on the incidence of scoliosis.

Investigation into the incidence of adolescent idiopathic scoliosis specifically with the use of radiographic studies.

The use of other objective measurements to determine whether the scoliosis is structural or non-structural, example measuring leg length inequality and side-bending tests.

Investigation into the physical activity levels of children diagnosed with scoliosis and the effect of physical activity on this condition.

Investigation into the incidence of scoliosis in rural areas and other cities across South Africa to obtain a more national statistic for this condition.
CHAPTER SEVEN

REFERENCES
Amended Employment Equity Act (No. 55 of 1998), Chapter 1: Definitions, Purpose, Interpretation and Application.


Government Gazette, Republic of South Africa (9\textsuperscript{th} January 2004), Volume 463, No. 25899, 

Haldeman, S., (DC, PhD, MD, DSc (hon.), FCCS(C), FRCP(C)) (1992), \textit{Principles and Practice of Chiropractic, 2\textsuperscript{nd} Edition.} Appleton and Lange, USA, pp 324, 325, 401, 627.


National Scoliosis Foundation (2005), Information and Support, nationalscoliosisfoundation.com.

Schafer, R.C., (DC, FICC) and Faye, L.J., (DC, FCCSS (c) Hon.) (1990), Motion Palpation and Chiropractic Technique – Principles of Dynamic Chiropractic, 2nd Edition. The Motion Palpation Institute, California, pp 151, 289.


Appendix A

School Consent Form
A Study to Determine the Incidence of Scoliosis in School Children

Dear Headmaster/Headmistress

I, Andrew van Rensburg, an M Tech Chiropractic student at the University of Johannesburg, am conducting a research study into the incidence of scoliosis in primary school children. I would be most appreciative if I could include your school in this study.

This study aims to find out what percentage of primary school children aged 10 to 11 have scoliosis of the spine. Scoliosis is a condition in which the spine has deviated from the midline to give it a “C” or an “S” shape. National screening for this condition was discontinued 10 years ago by the government in South Africa. It is the aim of this study to find out if there has been any significant change in incidence over the past 10 years.

Screening of the spine for scoliosis requires observational methods only. The methods to be used in this study require the child to stand against a vertical plumb line (a piece of string hanging down) to check the spine for deviation from this vertical line. The child is then required to bend over forward so that the skyline of the back can be checked for a rib hump (a sign of scoliosis). Children will be screened individually and privately under the observation of a teacher. These methods of screening are harmless, non-invasive and preserve the dignity of the child.

Learners will be chosen randomly for this study by a member of the school staff and must include an equal split of male and female learners. Girls will be required to wear swimming costumes so that their backs can be seen. Only 30% of the learners between the age of 10 and 11 are needed for the screening. A member of the school staff, preferably female, will be requested to assist with the screening process as co-ordinator and observer.

Potential benefits of this study are to provide a foundation of information on this condition to assist medical researchers in finding solutions to the many problems surrounding scoliosis.
Participation in this study is voluntary and free of charge. Participants are free to refuse participation or to withdraw from participation at any time. All information about individuals participating in this study is confidential and will be kept as such. Thank you for your assistance and participation in this study. For any queries or concerns that may be present the following people may be contacted:

Andrew van Rensburg (Researcher) at (082) 880-0688
Dr. M. Buchholtz (Supervisor) at (011) 972-8233
Dr. M. Moodley (Co-supervisor) at (011) 4062482

I have fully explained all the procedures involved in this project. I have asked if the participant has any questions regarding the procedures and have answered these to the best of my ability.

Date: ___________________________ Researcher: _______________________________

I, the headmaster/headmistress, have been fully informed about the procedures involved in this research. In signing this consent form I am agreeing to have this study conducted at the below-mentioned primary school. I understand that my consent may be withdrawn at any time and at my discretion.

Date: ___________________________ Headmaster/Headmistress: _______________________

Primary school: ________________________________________________________
Appendix B

Participant Information and Consent Form
A Study to Determine the Incidence of Scoliosis in School Children

Dear parent/guardian

I, Andrew van Rensburg, an M Tech Chiropractic student at the University of Johannesburg, am conducting a research study into the incidence of scoliosis in primary school children aged 10 to 11 years. I would be most appreciative if you would allow your child to partake in this study. The head of the school has agreed to this study taking place at your child’s school but your permission is also required.

This study aims to discover what percentage of primary school children aged 10 to 11 years have scoliosis of the spine. Scoliosis is a condition in which the spine has deviated from the midline to give it a “C” or an “S” shape. National screening for this condition was discontinued 10 years ago by the government in South Africa. It is the aim of this study to find out if there has been any significant change in incidence over the past 10 years.

Screening of the spine for scoliosis requires observational methods only. The methods to be used in this study require the child to stand against a vertical plumb line (a piece of string hanging down) to check the spine for deviation from this vertical line. The child is then required to bend over forward so that the skyline of the back can be checked for a rib hump (a sign of scoliosis). Children will be screened individually and privately under the observation of a teacher. Girls are required to wear swimming costumes so that their backs may be seen. These methods of screening are harmless, non-invasive and preserve the dignity of the child.

Participation in this study is free of charge and consent may be withdrawn at any time. All information gathered from individuals will remain private and confidential. For feedback on the trial parents may contact me, Andrew van Rensburg, on the number listed below. Participation in this study will contribute greatly to the body of medical knowledge and is completely without risk to participants.
Any questions or concerns regarding this study may be directed to the school head or the following people:

Andrew van Rensburg (Researcher) at (082) 880-0688
Dr. M. Buchholtz (Supervisor) at (011) 972-8233
Dr. M. Moodley (Co-supervisor) at (011) 406-2482

I have fully explained all procedures involved in this study and have answered any questions the participant, their parents or guardians may have to the best of my ability.

Date: ____________________________ Researcher: __________________________________

I have been fully informed about the procedures involved in this research. I understand that I, or the child participating in this study, may withdraw from participation at any time. In signing this consent form I am agreeing to the participation of this child in the study.

Date: ________________ Parent: ____________________ Guardian: _____________________

Name of Child Participating in Study: _______________________________________________
Appendix C

Data Collection Form

Primary School: ________________________________________________________________

Area: _________________________________________________________________________

Name of Participant: ____________________________________________________________

Age: ________________________ Gender: _____________ Race: _______________________

Name of Assistant: ______________________________________________________________

Adams Position Positive for Scoliosis: _____________________________________________

Erect Position Positive for Scoliosis: _____________________________________________

Researcher: ______________________________ Date: ________________________________

Notes: ________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________