SCHOOL SCOLIOSIS SCREENINGS: FAMILY EXPERIENCES AND POTENTIAL ANXIETY AFTER ORTHOPEDIC REFERRAL

APPROVED BY SUPERVISORY COMMITTEE

Betsy Kennard, Psy.D.

Sandra Roland, Ph.D.

Heather Richard, Psy.D

Carroll Hughes, Ph.D.

Shawn McClintock, Ph.D., M.S.C.S.

DEDICATION

My journey leading to and throughout graduate training has been challenging, arduous, impactful, exhilarating, and the greatest period of growth and self-development of my life. Because of this, friends, family, mentors, supervisors, and classmates have seen me at my absolute best and absolute worst. Despite my changes, lack-of-sleep-grumpiness, or "I'm too busy" excuses, I have felt supported, encouraged, and loved the entire way. I could not be more grateful for the faith so many people have had in me throughout this process. I dedicate this dissertation and my degree to all those who saw me through this… I could not have done it without you.

Specifically, I'd like to thank my committee who supervised and supported me in creating and writing this dissertation project, I am thankful for the autonomy provided to pursue a project I care about while simultaneously having your doors open for me to ask a million questions along the way. I have been blessed with a committee who genuinely cares about my well-being through this project and are my cheerleaders seeing me through to the end. I am grateful for the support provided by Dr. Herring, Dr. Ramo, and their teams at TSRHC to complete this project in a timely manner. To Dr. McClintock, I must thank you for your years of mentorship that began prior to this program. You believed in me before I believed in myself, and your words of encouragement will continue to guide me throughout my career.

To my classmates, I am thankful everyday to have you all in my cohort. I could not begin to imagine going through this process without each and every one of you, who have

individually kept me sane at one point or another. I love you all. To the Trevino's, thank you both for your career and life guidance, words of wisdom, friendship, and statistical talents shared with me.

To my best friends of all time, Shauna Barnes and Emily Stephens, you both somehow still love me despite my absenteeism over the last four years of graduate school. Despite my busyness, forgetfulness, and introversion, you both remain the truest and purest friends that any person could ever ask for. I did something right in a past life to be blessed with you two.

To Matthieu, thank you for your instantaneous and unwavering kinship. You are the once-in-a-lifetime soul mate that I thought I would never find but hoped for everyday. Your presence in my life reminds me to be true to myself and pursue my dreams.

To my sister, Megan, thank you for always reminding me to be grateful for who I am and what I do best. I have always admired you for your talents, artistry, humor, and free spirit, yet you do the same of me. You remind me that I am meant to harness my own strengths, yet I always know that I can share in your talents with you. You are the most precious thing in the world to me.

Last but not least, to my parents. I thank you for the instillation of intellectual drive, motivation, will power, and determination. Mom, you gave me my sensitivity, empathy, and pure heart. Dad, you gave me my insight, social attunement, and commonsense. It is all these tools together that have allowed me to successfully embark on this career as psychologist. Together, you have imparted the importance of education, positive work ethic, and following your heart. I hope I have made you proud.

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by

TABATHA KAY HINES

DISSERTATION

Presented to the Faculty of the Graduate School of Biomedical Sciences

The University of Texas Southwestern Medical Center at Dallas

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

The University of Texas Southwestern Medical Center at Dallas

Dallas, Texas

August, 2014

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TABATHA KAY HINES

The University of Texas Southwestern Medical Center at Dallas, 2014

SANDY ROLAND, PH.D.

Mentor, Texas Scottish Rite Hospital for Children (TSRHC)

ABSTRACT

BACKGROUND: Prevalence of adolescent idiopathic scoliosis (AIS) is approximately 2-4% (Reamy & Slakey, 2001). Implementation of mass school screening programs for early detection of AIS has been utilized to prevent curve progression (Luk et al., 2010). Use of school scoliosis screenings (SSS) remains controversial, due to a high rate of false-positive referrals and excessive costs (Fong et al., 2010). Literature frequently alludes to child/parent experiences of anxiety resultant from SSS referrals as a reason to end SSS programs. No systematic study of SSS referral processes associated with anxiety in families has been

conducted. AIMS: Knowledge of the level of psychological sequelae, particularly anxiety, subsequent to these referrals will inform SSS referral process overall costs/benefits to families. Enhanced understanding of the family's experience during the SSS referral process will allow for improvement of the SSS process from a psychological perspective. Methods: The study consisted of two groups – a patient group of patients from TSRHC (n=27) and a control group (n=27) between ages 9 and 17. One parent per participant also participated. All participants completed the primary outcome measure (State-Trait Anxiety Inventory) at two time points – before and after initial scoliosis evaluation for the patient group, and before and after a controlled wait period for the control group. Parents also completed a questionnaire rating their experience and satisfaction with the SSS referral process.

RESULTS/CONCLUSIONS: Children and parents in the patient group experienced significantly elevated levels of state-anxiety upon arrival to the hospital than those in the control group. This supports the subjective concerns of anxiety experienced in families as voiced by researchers evaluating SSS programs. All participants reported a decline in their experience of state-anxiety from the start to end of their appointment, regardless of evaluation outcome. This suggests a certain amount of anticipatory anxiety may be present when arriving to the hospital that declines with comfort with the hospital/staff members. Children and parents in the patient group not diagnosed with AIS experienced a significant decline in state-anxiety from pre to post, when controlling for trait-anxiety. Children and parents in the patient group diagnosed with AIS continued to report significantly elevated levels of anxiety. The control group also remained consistent in their reports of low anxiety from the beginning to end of appointment. Results reveal a high false-positive referral rate at

51.9% referred who were negative for an AIS diagnosis. Only 22% of those referred required treatment at this time. More than half (55.5%) indicated that they did not receive information from the school about scoliosis or the referral/evaluation process. A third (33.3%) of the families who did receive information indicated the information did not adequately address their concerns. This lack of information dissemination may largely explain the presence of anxiety in these families that decreased by the end of their TSRHC appointment with the receipt of more information provided by the medical team. Results suggest that despite the experience of anxiety going into the appointment and despite the outcome of the appointment (diagnosis or not), families report overall satisfaction with SSS and appear to appreciate the value/benefit of the SSS program and the evaluation process. IMPLICATIONS: Results suggests families deem the costs of the referral process (emotional, financial, and time) as worth the benefits of the referral and evaluation process. Though researchers, legislators, and medical professionals were accurate in their perception of anxiety in families, it may not constitute a significant enough burden to consider it a reason for dismissal of SSS programs. A lack of information dissemination may largely explain the presence of anxiety in these families that decreased by the end of their TSRHC appointment with the receipt of more information provided by the medical team. This demonstrates and area of improvement for the SSS programs.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF DEFINITIONS

AAOS – American Academy of Orthopaedic Surgeons

AAP – American Academy of Pediatrics

AFB – Adam's Forward Bend test

AIS – Adolescent Idiopathic Scoliosis

ASF – Anterior Spinal Fusion

IS – Idiopathic Scoliosis

PSF – Posterior Spinal Fusion

SRS – Scoliosis Research Society

SSS – School Scoliosis Screening

STAI – State-Trait Anxiety Inventory

TSRHC – Texas Scottish Rite Hospital for Children

USPSTF – United States Preventative Services Task Force

CHAPTER ONE
Introduction

The purpose of the present study is to assess the impact of School Scoliosis Screening (SSS) programs on anxiety in both children and parents after being referred for a scoliosis orthopaedic evaluation. The prevalence of adolescent idiopathic scoliosis is approximately 2 to 4% in the 10 to 16 year-old age group (Reamy & Slakey, 2001). As a majority of spinal curves are detectable during adolescence, the implementation of mass school screening programs for early detection of adolescent idiopathic scoliosis (AIS) was initiated in the late 1950's (Luk et al., 2010). This was an important program as patients with severe spinal deformities may suffer from a higher risk of mortality or morbidity; thus, early detection is ideal for the prevention and/or treatment of curve progression (Pehrsson, Larsson, Oden, & Nachemson, 1992). However, the use of SSS remains controversial, mainly due to a high rate of false-positive referrals and excessive costs to families and the health care industry (Fong et al., 2010). The United States Preventative Services Task Force in 2004 (USPSTF, 2004) advised against SSS due to evidence of unnecessary back bracing prescriptions and high rates of unnecessary referrals for specialty care (Luk et al., 2010). On the contrary, the American Academy of Orthopedic Surgeons, the Scoliosis Research Society, the Pediatric Orthopedic Society of North America, and the American Academy of Pediatrics continue to support SSS for early detection (Luk et al., 2010).

An important area of concern that has received limited attention is the psychological costs that are associated with potentially having a significant medical condition, and anxiety

regarding the possible diagnosis and invasive treatments of scoliosis (Lee et al., 2010a). Previous literature frequently alludes to child and parent experiences of anxiety resultant from SSS referrals. From a mental health perspective, the high rate of false-positive referrals calls into question the ultimate benefit of the screening (Grivas, Vasiliadis, & O'Brien, 2008; Grivas, Vasiliadis, & Rodopoulos, 2008; Grivas, Wade, et al., 2007; Kapoor, Laham, & Sawyer, 2008; Lee et al., 2010a, 2010b; Morrissy, 1999). To date, there has been no systematic study of SSS referral processes associated with anxiety in children and parents, despite the clinical observations by the medical treatment team of increased anxiety levels in patients and families during their initial clinical evaluations. Indeed, this has been the case at Texas Scottish Rite Hospital for Children (TSRHC). Moreover, prior research on the effectiveness of the SSS programs revealed that little to no formal health education materials were distributed to children or parents within the current SSS program (Velezis, Sturm, & Cobey, 2002).

Knowledge of the level of psychological sequelae, particularly anxiety, subsequent to these referrals will further inform this referral process and SSS programs' overall benefits and costs to families. This study therefore aims to collect objective data on anxiety, which will allow us to first understand if SSS programs result in higher anxiety levels for caregivers and/or adolescents when the adolescent does not meet diagnostic criteria for idiopathic scoliosis after orthopaedic evaluation. Another goal of this study is to investigate the cost/benefit ratio of SSS and the percentage of false-positive referrals produced with current SSS methods. Finally, this research study aims to enhance the understanding of anxiety levels experienced by children and parents to allow for improvement of the SSS process from

a psychological well-being perspective. Indications for improvement could include enhanced education and preparation provided to families about the SSS referral process and scoliosis in general.

CHAPTER TWO
Review of the Literature

ADOLESCENT IDIOPATHIC SCOLIOSIS

Idiopathic Scoliosis Classification

The Scoliosis Research Society (SRS) has defined scoliosis as a lateral curvature of the spine with greater than 10 degrees when measured using the Cobb method on a standing radiograph (Reamy & Slakey, 2001). Scoliosis is understood to be a three dimensional deformity of the spine with deformation in the sagittal (thoracic lordosis), frontal (lateral curvature), and transverse planes (vertebral rotation) (Kouwenhoven & Castelein, 2008; Weiss, 2008; Wise, Gao, Shoemaker, Gordon, & Herring, 2008; Wong & Liu, 2003). Curves of the spine measuring less than 10 degrees are considered normal deviations as they have a slim probability of progression (Dolan & Weinstein, 2007; Weiss, 2008; Wong & Liu, 2003). Idiopathic scoliosis is a structural lateral and rotary curve of the spine with no identified cause, though secondary causes for idiopathic scoliosis can be identified through radiography and clinical examinations (Dolan & Weinstein, 2007; Reamy & Slakey, 2001; Wise et al., 2008). Adolescent idiopathic scoliosis is most often identified in otherwise healthy children during puberty (Dolan & Weinstein, 2007; Wise et al., 2008).

Idiopathic scoliosis is categorized into three age groups, based on when it is first identified. These categories include, 1) infantile idiopathic scoliosis, 2) juvenile idiopathic scoliosis, and 3) adolescent idiopathic scoliosis (Reamy & Slakey, 2001). Infantile idiopathic

scoliosis has an onset before age three and is prevalent in fewer than one percent of all cases (Reamy & Slakey, 2001). The juvenile classification is first detected between ages three and nine and accounts for approximately 12 to 21 percent of all idiopathic scoliosis cases (Reamy & Slakey, 2001). Finally, adolescent idiopathic scoliosis (AIS) is classified as being first identified at age 10 through skeletal maturity (late adolescence) (Reamy & Slakey, 2001). AIS is the most prevalent form of idiopathic scoliosis (Reamy & Slakey, 2001; Wise et al., 2008).

AIS Prevalence

Adolescent idiopathic scoliosis prevalence rates have been estimated between 2 and 4 percent of adolescents between ages 10 and 16 years, and appears to affect all ethnic populations (Reamy & Slakey, 2001; Wise et al., 2008; Wong & Liu, 2003). A report by the Scoliosis Research Society in 1982 noted that 2 to 3 percent of adolescents younger than age 16 have a curve of less than or equal to 10 degrees, whereas .3 to .5 percent will have a curvature equal to or greater than 20 degrees (Dolan & Weinstein, 2007). An estimated 602,884 visits to private physician offices in 1995, were associated with the ICD-9 diagnostic code for idiopathic scoliosis (Dolan & Weinstein, 2007). Of adolescents initially diagnosed with AIS, 10 percent have a progression of the curve that requires medical intervention (Reamy & Slakey, 2001). In 2000, this translated to more than 4,500 surgeries performed in the United States for the primary diagnosis of AIS in adolescents between ages 10 and 18 (Dolan & Weinstein, 2007). Prevalence rates of AIS decline as the severity of the curvature increases.

Curves greater than 30 degrees are approximately .2 percent of the population, and the prevalence for curves greater than 40 degrees is approximately .1 percent (Reamy & Slakey, 2001). Smaller curves of less than 10 degrees have an equal ratio of girls to boys; however, there is a substantial increase in the prevalence rate for girls with curves of 30 degrees or more—representing a 10 to 1 ratio (Reamy & Slakey, 2001; Wong & Liu, 2003). The disparity in females to males ratio at greater than 30 degrees is due to the tendency of curves to progress more often in females than males (Reamy & Slakey, 2001).

Natural History & Prognosis of AIS

After a diagnosis of scoliosis has been determined, health professionals become concerned with identifying an underlying cause (if possible) and attempting to determine if the curve is likely to progress (Reamy & Slakey, 2001). Regarding curve progression, there are three main determinants considered: 1) the patient's gender, 2) future growth potential, and 3) the curve magnitude at the time of diagnosis (Reamy & Slakey, 2001; Weiss, 2008; Wise et al., 2008). The probability of curve progression is higher in patients with greater growth potential and a larger curve (Lonstein & Carlson, 1984; Reamy & Slakey, 2001; Wise et al., 2008).

The evaluation of growth potential has been previously assessed using the Tanner stage of pubertal development (stages 1 through 5) and the Risser grade of skeletal growth (scaled 0 through 5) (Reamy & Slakey, 2001). Tanner stages 2 and 3 occur just after the onset of the pubertal growth spurt and is the time of maximum progression of scoliosis (Reamy & Slakey, 2001). The Risser grade (on a scale from 0 to 5) provides an estimate of

the amount of skeletal growth that remains by grading the progress of bony fusion of the iliac apophysis of the pelvis (see Figure 1) (Reamy & Slakey, 2001). This iliac apophysis ossifies in a predictable way from the anterolateral to the posteromedial along the iliac crest, thus making predictions possible for skeletal growth (Reamy & Slakey, 2001). Risser classifications are delineated on a five point scale: grade 0 (zero) signifies no ossification, grade 1 signifies up to 25 percent ossification, grade 2 signifies between 26 to 50 percent ossification, grade 3 signifies between 51 to 75 percent ossification, grade 4 signifies between 76 to 100 percent ossification, and grade 5 signifies complete bony fusion of the apophysis (Reamy & Slakey, 2001). Recently, pediatric orthopedists have used the Tanner-Whitehouse-III RUS (radius, ulna, small bones of the hand) method to more accurately determine bone age (see Figure 2) (Sanders et al., 2008). The RUS method uses the distal, radial, and ulnar epiphyses (the rounded end of a long bone, at its joint with adjacent bones) and the metacarpal and phalangeal epiphyses of the first, third, and fifth digits to determine skeletal age (Sanders et al., 2008). Each bone is assigned a specific maturity score based on the bone development at the epiphyses, and then the individual bone scores are added to obtain a total RUS score (Sanders et al., 2008).

Curve magnitude is determined by measuring the patient's Cobb angle (Reamy & Slakey, 2001). Cobb angles are measured from a standard posteroanterior standing radiograph of the spine (Reamy & Slakey, 2001). The Cobb angle is the angle formed when a line is drawn perpendicular to the top of the superior vertebrae of the scoliotic curve and a similar perpendicular line drawn along the bottom of the inferior vertebrae (Reamy & Slakey, 2001). Research suggest that curves with a Cobb angle of less than 30

degrees at bone maturity (based on Risser grade) are unlikely to progress (Lonstein & Carlson, 1984; Reamy & Slakey, 2001). However, curves with a magnitude of 30 to 50 degrees at bone maturity progress on average of 10 to 15 degrees over a lifetime (Lonstein & Carlson, 1984; Reamy & Slakey, 2001). When curves are greater than 50 degrees at maturity, they will likely progress at a rate of 1 degree per year over a lifetime (Reamy & Slakey, 2001). An estimated 10% of patients with AIS have curves that progress to 50 degrees or higher (Weinstein, Dolan, Wright, & Dobbs, 2013a).

Some of the more common complications found in patients with higher degrees of curvature include disproportionate body growth, spine immobility, and significant back pain (Dolan & Weinstein, 2007; Wong & Liu, 2003). As degree magnitude increases (i.e. over 100 degrees), life-threatening effects on pulmonary function are more likely. However, curves of this magnitude are uncommon in AIS (Dolan & Weinstein, 2007; Pehrsson et al., 1992; Reamy & Slakey, 2001; Wong & Liu, 2003). Additionally, anthropometric studies have analyzed body length in AIS patients compared to normal children. A systematic review of these studies reveal that AIS patients are taller and more slender compared to their peers (Kouwenhoven & Castelein, 2008). Researchers have hypothesized that this growth rate disparity may be a causative factor in the development of AIS (Kouwenhoven & Castelein, 2008). However, the proportion of leg length to trunk length in AIS patients was found to be the same as in the normal population, which indicates a generalized growth disturbance in AIS rather than one confined to just the spine (Kouwenhoven & Castelein, 2008). Upon further investigation, it has been determined that children with AIS are not necessarily growing faster than their peers, rather they appear to be taller because of the flattening of the

thoracic kyphosis (the upper part of the spine) (Kouwenhoven & Castelein, 2008). Thus, it has been generally accepted, that while growth is related to scoliosis development and progression, it is not a causative factor (Kouwenhoven & Castelein, 2008).

A study by Pehrsson et al. (1992) examined the long-term effects of patients with untreated idiopathic scoliosis. Their results indicated that there is an increased mortality rate in patients with surgically untreated scoliosis by means of respiratory failure. This was especially the case with patients who had earlier onset (before age 8) (Pehrsson et al., 1992). However, these researchers determined through literature reviews and their own investigation that respiratory failure and premature death are not indicated in adolescent onset of idiopathic scoliosis (Pehrsson et al., 1992).

AIS Pathophysiology

The pathophysiologic process that underlies idiopathic scoliosis has yet to be fully determined (Reamy & Slakey, 2001; Wong & Liu, 2003). Multiple abnormalities have been discovered; however, there is inconclusive evidence to link all cases of idiopathic scoliosis (Reamy & Slakey, 2001; Wong & Liu, 2003). Pre-clinical models of reproduced idiopathic scoliosis have been attempted; however, no single cause has been identified. Thus idiopathic scoliosis has been considered a multifactorial inheritance condition that involves several to many genetic and epigenetic factors (Kouwenhoven & Castelein, 2008; Reamy & Slakey, 2001; Wise et al., 2008). Twin studies have provided significant evidence of genetic influence (Reamy & Slakey, 2001). Meta-analytic studies have determined that the risk for

scoliosis is greater in monozygotic twins and that the rate of curve progression is nearly identical among twins subjected to a variety of environmental influences (Reamy & Slakey, 2001; Wise et al., 2008).

A linkage study of 53 families identified a large region of chromosome 8q12 (near the gamma-1-syntrohon (SNTG1) gene) linked with idiopathic scoliosis (Gao et al., 2007; Wise et al., 2008). Additional analysis found that this signal was partially due to a different gene encoding the chromo-domain helicase DNA binding protein 7 (CHD7), that was both linked and associated with idiopathic scoliosis (Gao et al., 2007; Wise et al., 2008). These investigators reported that multiple single nucleotide polymorphisms (SNPs) in CHD7 were significantly associated with increased risk for developing idiopathic scoliosis (Gao et al., 2007; Wise et al., 2008). Based on these findings, the investigators concluded that the presence of disease in siblings was genetically related, but that separate factors may influence both disease severity and outcome (Gao et al., 2007; Wise et al., 2008).

A more recent study by Kou et al. (2013), determined that chromosomes 10q24 and 6q24 were associated with AIS susceptibility that explained approximately 1% of the trait variance in AIS. This study recommended that a global genome-wide meta-analytic association study of existing AIS data is the next step to further understand the disease pathophysiology (Kou et al., 2013).

Screening & Assessment of AIS

Efficient and accurate initial identification of idiopathic scoliosis is often challenging. Many, if not most, AIS patients are identified during routine screenings or incidentally during well-child examinations because of trunk asymmetry rather than reported symptoms (Dolan & Weinstein, 2007). Mass screenings have often been utilized in schools over the past years; however, over-referral of adolescents with insignificant curves have led to a marked global decrease in the utilization of school screening programs across (Reamy & Slakey, 2001). Complaints about the efficiency, accuracy, and cost effectiveness of school screening programs is currently in question (Wong & Liu, 2003). Recent studies have concluded that over-referral is common even with the use of multiple diagnostic modalities (Reamy & Slakey, 2001).

Despite the high scoliosis prevalence rates and associated symptoms, routine screenings of idiopathic scoliosis remains controversial. The American Academy of Orthopaedic Surgeons, Scoliosis Research Society, Pediatric Orthopaedic Society of North America, and American Academy of Pediatrics agree that females should be screened twice at ages 10 and 12 (grades 5 and 7), and boys once, at age 13 or 14 (grades 8 or 9) (SRS, 2013). The U.S. Preventive Services Task Force (USPSTF) noted in 1996 that, "there is insufficient evidence for or against routine screening of asymptomatic adolescents for idiopathic scoliosis. Clinicians should remain alert for large spinal curvatures when examining adolescents" (USPSTF, 1996). However in 2004, the USPSTF changed their recommendation, stating that a low predictive value of screening, a small percentage of

children who progress, and the possibility of unnecessary treatment including bracing, warranted a recommendation against the routine screening of asymptomatic adolescents for idiopathic scoliosis (USPSTF, 2004). Of note, the Task Force's recommendation change was largely based on a modification in methodological approach rather than new information (SRS, 2013).

Despite the ambiguity surrounding scoliosis screenings, there are several recommended modalities for assessing and diagnosing idiopathic scoliosis. First and foremost, a thorough history and physical examination is necessary to exclude any secondary causes for spinal deformities (Reamy & Slakey, 2001). Some information to be considered is a family history of scoliosis, menstrual onset in females, and the presence of pain and neurologic changes (e.g., bowel and bladder dysfunction) (Reamy & Slakey, 2001). Physical examination includes the assessment of the Tanner stage of pubertal development (peak curve progression occurs during Tanner stage 2 or 3) and a complete neurologic examination (Reamy & Slakey, 2001). Abnormal neurologic findings, such as cutaneous lesions including any café au lait spots, midline hairy patches, sinuses, or clefts should be noted as these may be indicative of other underlying disorders, including neurofibromatosis or spinal dysraphism (Hart, 2006; Reamy & Slakey, 2001).

The Adam's Forward Bend (AFB) Test is often utilized for initial assessment, as it requires no additional equipment (Reamy & Slakey, 2001). With this assessment, the child bends forward at the waist until the spine is parallel with the horizontal plane, while holding palms together with arms extended (Reamy & Slakey, 2001). The examiner then looks along the horizontal plane of the spine from the back and side to determine if there is asymmetry in

the contour of the back, which is known as a "rib hump" (see Figure 4) (Reamy & Slakey, 2001). When a rib hump is present, this signals that a curve of greater than 10 degrees is likely present, which warrants subsequent radiographic evaluation (Reamy & Slakey, 2001). As 90 percent of thoracic curves are to the right, a left curve is an atypical presentation that warrants an extensive evaluation (Reamy & Slakey, 2001). Other concerning symptoms that should be considered red flags include: severely painful scoliosis, untoward stiffness, deviation to one side during the forward bend test, sudden rapid progression in a previously stable curve, extensive progression after skeletal maturity, abnormal neurologic findings, and the stigmata of other clinical syndromes associated with spinal curvature (Reamy & Slakey, 2001).

When scoliosis is suspected after initial screenings, radiographic imaging is essential as the final exam for diagnosis (Reamy & Slakey, 2001; Wong & Liu, 2003). A posterior-anterior view x-ray film is typically used to determine the measurement of the curve using the Cobb method (Wong & Liu, 2003). The x-ray film is also used to assess skeletal maturity of the patient based on the Risser grade from 0 (no ossification of the iliac apophysis) to 5 (fully ossified ilia apophysis) (Reamy & Slakey, 2001; Wong & Liu, 2003). When there is a left thoracic curve, unusual pain, or abnormal neurologic examination, the use of magnetic resonance imaging (MRI) is indicated to rule out spondylolisthesis, tumors, and syringomyelia (Reamy & Slakey, 2001).

AIS Referral Guidelines & Treatment

Adolescent idiopathic scoliotic curves that have been determined to have a low risk of progression are often followed by a family physician without treatment (Reamy & Slakey, 2001). However, curves with a likelihood of progression in patients with continued growth remaining are to be referred to an orthopedic specialist (Reamy & Slakey, 2001). Many non-surgical treatment options have been researched; however, few have shown appropriate management of curve progression (Reamy & Slakey, 2001). Chiropractic care, biofeedback, and electric stimulation been unable to prevent curve progression (Fusco et al., 2011; Reamy & Slakey, 2001). There are some reports that physical exercise may have some efficacy in halting curve progression, though bracing and spinal surgery are considered the most effective treatment modalities (Reamy & Slakey, 2001). The level of treatment is based on severity of curve and likelihood of curve progression. Surgery is usually considered for Cobb angles measuring greater than 40 degrees for younger patients to prevent further progression (Wong & Liu, 2003). In patients with curves between 25 and 45 degrees with likelihood of progression, orthotic intervention is often pursued (Katz & Durrani, 2001; Wong & Liu, 2003). Younger patients with Cobb angles measuring less than 25 degrees are less likely to have progression. Therefore, observation throughout their growth period, rather than immediate treatment, is recommended (Wong & Liu, 2003).

Physical Exercise

A study by Negrini et al. (2008) showed that physical exercise was a beneficial treatment for AIS with regard to Cobb angles. Also, it helped improve strength, mobility, and balance. Fusco et al. (2011) noted that the use of exercise can positively influence the spinal curvature as well as increase neuromotor control, stability of the spine, reduce postural collapse, and increase breathing function. While these results are encouraging, further research is warranted, particularly in the form of randomized controlled trials (Fusco et al., 2011). As physical exercise has yet to be established as an effective treatment option with long-term results, orthotics and surgical interventions are generally first line treatment options.

Another non-invasive treatment option, known as the Schroth regimen, is currently being explored as an additional option for adolescents with milder curves. The Schroth regimen is a series of muscle-strengthening and stretching exercises aimed to de-rotate and elongate the spine into a straighter position (Failey, 2013). It is considered a three-dimensional physical therapy exercise as it works to correct three planes: sagittal, coronal, and transverse (Failey, 2013). Additionally, the regimens are designed specifically to the individual's curve type (Failey, 2013). This method also focuses on curve-specific movement, body awareness, and mental imagery to improve posture (Failey, 2013). Though this non-invasive option sounds intriguing, few research studies have determined its efficacy (Failey, 2013). Currently, a study by Zapata et al. at TSRHC is underway to investigate this method in a population of AIS patients (Failey, 2013). Additionally, the University of Alberta in Canada is conducting trials to determine potential efficacy (Failey, 2013).

Bracing/Orthotics

Spinal braces are often utilized to treat mild to moderate curves (25 to 45 degrees) to minimize curve progression and prevent the need for surgical intervention (Wong & Liu, 2003). Orthotic braces for the spine are divided into main categories based on the level of the spine that the orthosis covers (Wong & Liu, 2003). The most common spinal braces are the Cervical-Thoracic-Lumbar-Sacral Orthosis (CTLSO) and the Thoracic-Lumbar-Sacral Orthosis (TLSO) (Wong & Liu, 2003). The CTLSO is the most rigid orthosis as it consists of a neck ring connected with vertical bars that only allows slight head and neck movements (Wong & Liu, 2003). Conversely, TLSOs have no vertical bars and wrap around the chest down to the pelvis (Wong & Liu, 2003). The most common TLSOs utilized are the Boston, Charleston, Providence, and Cheneau orthosis (named from the city of origin) (Wong & Liu, 2003). Brace wear time also depends on the brace type. The CTLSO is worn full-time (23 hours a day), whereas TLSOs are worn part time for approximately 8 or 16 hours (Wong & Liu, 2003). Typically, brace wear is recommended until skeletal maturity is reached (2-4 years of treatment), unless curve progression occurs during brace wear (progression of 5 degrees or more). In the latter case, the treatment team may consider surgical options (Katz & Durrani, 2001; Weinstein et al., 2013a).

Brace wear compliance has been determined as an important predictor of brace effectiveness (Katz & Durrani, 2001; Wong & Liu, 2003). Two studies by Katz et al. (Katz & Durrani, 2001; Katz, Herring, Browne, Kelly, & Birch, 2010) reported that treatment success was most associated with patients who wore their brace at least 12 hours a day. More recently Katz et al. (2010) monitored brace wear with the use of heat sensors embedded in

the brace. Results confirmed the association between brace wear time and reduced curve progression, which was inversely associated with the need for surgical treatment (Katz et al., 2010). The overall rate of compliance with prescribed brace wear was 35% and 27% in the 16 hour and 23 hour brace prescriptions, respectively (Katz et al., 2010). This indicated that adolescents struggle to adhere to such a demanding and time intensive treatment course.

A recent multicenter study by Weinstein et al. (2013b) compared the effectiveness of bracing to that of only observation. In a randomized, intent-to-treat cohort, the treatment success rate was 75% after bracing compared to 42% after observation (Weinstein et al., 2013b). Treatment success was defined as reaching skeletal maturity without a curve progression reaching 50 degrees (Weinstein et al., 2013b). Curve progression to 50 degrees requires surgical intervention and was therefore considered a treatment failure (Weinstein et al., 2013b).

Surgical Options

While surgical techniques may vary, the goals for surgery of AIS are shared among surgeons: 1) halt curve progression and correct deformity, 2) maintain a balanced spine in the coronal and sagittal planes, 3) preserve as many mobile and spinal segments as possible, and 4) prevent surgical complications such as junctional kyphosis, adding-on, or revision surgery (Fischer & Kim, 2011). Surgical treatment of AIS involves the use of metal implants attached directly to the spine, which are then connected to two rods (SRS, 2013). This system is designed to straighten the spine and hold the spine in the corrected position until the instrument's spinal segments fuse as one bone (SRS, 2013). There are two surgical

techniques that can be utilized to achieve this result, the first being performed from the back of the spine (Posterior Spinal Fusion or PSF), and the other being performed from the front of the spine (Anterior Spinal Fusion or ASF) (SRS, 2013). The PSF is currently the most commonly utilized approach (SRS, 2013).

During post-surgical recovery, there is no requirement for external bracing or casting (SRS, 2013). Hospitalization is typically three to six days, and pain medication is generally discontinued after 10 to 14 days post-operation (SRS, 2013). The patients are typically able to return to regular daily activities within 3 to 4 weeks with full recovery usually between three and six months after surgery (SRS, 2013).

Surgical revision is a significant concern following a PSF or ASF. A number of studies have attempted to better understand the causes for unanticipated revisions and report on the actual rate of revisions needed. Campos et al. (2012) reported on their revision rates after a total of 502 AIS surgeries. They reported a total of 24 revision surgeries performed for 23 patients (Campos et al., 2012). The main reasons for revision included residual rib deformity, correction of metal implants, and progression of the unfused compensatory curve (Campos et al., 2012). Ramo and Richards (2012) evaluated the overall reoperation rates and factors contributing to reoperation in a 5-year cohort of patients (2003-2007) at TSRHC. The revision rate for this AIS patient group was 7.5% (34 of 452 patients) (Ramo & Richards, 2012). The most common reasons for reoperation included symptomatic implant removal, infection, and curve progression (Ramo & Richards, 2012).

Long-term clinical outcomes have also been evaluated to determine the ultimate success of AIS surgeries. A study by Akazawa et al. (2012) reviewed 256 patients surgically

treated for AIS between 1968 and 1988. Their findings indicated that there were no demonstrable adverse effects on medical or mental health in these now middle-aged AIS patients 21-41 years post operation (Akazawa et al., 2012). They also noted that postoperative correction dramatically improved over the past 20 years due to significant advances in surgical methods and spinal instrumentation, which indicated a likelihood of even better postoperative outcomes in the future (Akazawa et al., 2012).

Regardless if surgical or non-surgical options are pursued, it is generally accepted that treatment outcomes are successful if there is less than 6-degree progression in the Cobb angle (Wong & Liu, 2003). If curve progression is minimal, it can be safely observed by the treating physician. For slightly more severe curves, bracing may slow or halt curve progression, if worn as prescribed until skeletal maturity. However, surgery is warranted for curves that continue to progress before the end of the high-risk period (Wise et al., 2008). Consequently, management of AIS, from screening to intervention, is a considerable health-care burden to patients, families, and clinicians (Wise et al., 2008).

SCHOOL SCOLIOSIS SCREENING PROGRAMS

Purpose of SSS Programs

A "screening" for health purposes is defined as "the presumptive identification of unrecognized disease or defects by the application of tests, examinations, or other procedures, which can be applied rapidly" (Morrissy, 1999). Screenings are intended to distinguish between those who may or may not have a disease, though they are not intended

to be diagnostic (Morrissy, 1999). School screenings for idiopathic scoliosis were developed to identify adolescents with spinal curves at an early stage, and refer them for diagnostic clarification before curve progression (Sater, White, & Haynes, 2011). Currently, all states participate in some form of spinal screenings to identify AIS as early as possible (Sater et al., 2011). Texas's SSS program is mandated through legislation to occur for all students in the 6th and 9th grades, using school nurses or other trained adults (Sater et al., 2011). Alternatively, Texas allows screenings to occur in 5th and 8th grade as well, so long as there is a three-year gap between screenings (Sater et al., 2011).

Screenings are not intended to diagnose AIS. Texas law instructs that students who appear to have a spinal curve be referred to a physician to receive a complete examination with x-rays to investigate the findings (Sater et al., 2011). The goal of Texas SSS programs is "to detect a student who needs to be referred at the earliest point, before an abnormal curve gets worse" (Sater et al., 2011). As AIS can rapidly progress during these high-risk periods of development in early adolescence, screenings were designed to provide the opportunity for early diagnosis, time to implement conservative treatment options, and reduce surgical rates (Grivas, Vasiliadis, & O'Brien, 2008).

History of SSS Program in United States

Spinal screenings have been implemented for over 60 years, with the first U.S. program initiated in Delaware in the late 1950's (Luk et al., 2010). Other states followed, either by implementing volunteer programs or through legislation (Luk et al., 2010). Minnesota's

program in 1973 pioneered future screening programs by offering a centrally-directed, statewide program, based on clinical examination (Grivas, Wade, et al., 2007). In 1984, the American Academy of Orthopaedic Surgeons (AAOS) and the Scoliosis Research Society (SRS) announced their endorsement of screening school children for early detection of AIS (Sabirin, Bakri, Buang, Abdullah, & Shapie, 2010).

Today, all 50 states perform some form of spinal screening in the school system, 21 of which have legislation mandating the implementation of school screenings (Sater et al., 2011), including (in order of year of legislation): Delaware, New Jersey, New York, Washington, Florida, California, Massachusetts, Maine, Rhode Island, Connecticut, Kentucky, Maryland, Pennsylvania, Georgia, Nevada, Alabama, Indiana, Texas, Arkansas, Utah, and Virginia (Grivas, Wade, et al., 2007). Programs in each state vary in their screening procedures, but all target the time when adolescents are beginning their rapid growth phase (Sater et al., 2011). As this study focuses on a Texas based population, the specific procedures utilized in Texas will be described in further detail.

Current SSS Procedures in Texas

Screenings (see Appendix B for complete program instructions)

The Texas Legislature has mandated that all children in 6th and 9th grades (or 5th and 8th grades) who attend public and private schools be screened for abnormal spinal curvature before the end of the respective school year (Sater et al., 2011). The law indicates that the screenings can be conducted by health aids, licensed vocational nurses, physical education

teachers, classroom teachers, and/or adult volunteers who have completed a spinal screening certification workshop through the Department of State Health Services (Sater et al., 2011). Licensed health practitioners (such as registered nurses, nurse practitioners, physician assistants, physicians, chiropractors, and physical therapists) are permitted to conduct screenings without prior certification if their course of study included physical assessment, or they received formal advanced instruction in spinal screenings (Sater et al., 2011).

Prior to screenings, the schools are instructed to "send out a pre-screening letter to the parents" and have the option of enclosing the "Watch Out for Scoliosis" brochure, if they choose (See Appendix C for examples of materials provided to parents) (Sater et al., 2011). During the screening, screeners are instructed to look for the following "signs" of AIS: one shoulder higher than the other, one shoulder blade higher or more prominent than the other, one hip higher than the other, space between arms and body greater on one side, leaning to one side, and the head not being centered directly above the pelvis (Sater et al., 2011). Screeners are provided with an instruction manual (see Appendix B) and pictures to help identify specific AIS features. The examination includes observing the student from the front, right side, left side, and back when standing erect, and again from all four positions when bending forward (known as the Adam's Forward Bend Test) (Sater et al., 2011). Screeners are asked to look for uneven contours or humps on one side, as well as any curvature observed in the spine (Sater et al., 2011). Based on the legislation, screeners have the option of utilizing a scoliometer to assist in their assessment, though this instrument is not a requirement (Sater et al., 2011). A scoliometer is similar to a carpenter's level and is designed to measure the degree of spinal rotation (Sater et al., 2011). Students who have

positive findings based on the initial screening are to be re-screened at the school within a two-week period to confirm initial findings (Sater et al., 2011).

Referrals

Screeners are informed that an official diagnosis of scoliosis must come from a physician. Screeners are responsible for providing proper documentation of the school spinal screening, which includes results of the initial screening, results of the re-screening, and referrals (Sater et al., 2011). Additionally, screeners are to attempt to receive results from the student's physician along with documenting the follow-up plan (Sater et al., 2011).

When initial positive findings are not confirmed at the re-screen, the school is not required to contact the student's parents (Sater et al., 2011). If a positive finding is confirmed at the re-screen, then the parent/guardian is to be notified by the school in writing with the screening findings. Parents are instructed to take these findings with them to the professional examination (see Parent Notification and Referral form in Appendix C) (Sater et al., 2011). The program guide for screeners indicates that the school may provide "a courtesy" telephone call to parents to explain that a professional evaluation is recommended as a precaution; however, phone calls are not standard nor required (Sater et al., 2011). Additionally, no timeline or deadline is provided in the procedural guidelines for when letters must be sent to the child's family (Sater et al., 2011) .

Effectiveness of SSS –The Controversy

Despite school screening programs being implemented in every state (in one form or another), the effectiveness and benefit of the programs have continually been called into question (Fong et al., 2010; Grivas, Vasiliadis, Maziotou, & Savvidou, 2007; Grivas, Vasiliadis, & O'Brien, 2008; Grivas, Vasiliadis, & Rodopoulos, 2008; Grivas, Vasiliadis, Rodopoulos, & Kovanis, 2008; Grivas, Wade, et al., 2007; Kapoor et al., 2008; Lee et al., 2010a; Luk et al., 2010; Sabirin et al., 2010). Supporters of SSS programs claim that they provide opportunity for early diagnosis, increased use of conservative treatments, and important data about the etiology, epidemiology, and natural history of AIS (Bremberg & Nilsson-Berggren, 1986; Grivas, Vasiliadis, & O'Brien, 2008; Grivas, Vasiliadis, Savvidou, & Triantafyllopoulos, 2008; Lonstein, 1988a, 1988b; McCarthy, Morrissy, & Dwyer, 1983; T. K. Taylor & Concannon, 1994). Institutions including the American Academy of Orthopaedic Surgeons (AAOS), Scoliosis Research Society (SRS), Pediatric Orthopaedic Society of North America (POSNA), and the American Academy of Pediatrics (AAP) have claimed to "not support any recommendation against scoliosis screening" (Grivas, Vasiliadis, & O'Brien, 2008). However, there have been an emerging number of consistent concerns preventing SSS programs from being more broadly accepted, including the low prevalence of AIS, high false-positive referral rate, excessive costs and burden to families, and effects of unnecessary radiation exposure (Adler, Csongradi, & Bleck, 1984; Goldberg, Dowling, Fogarty, & Moore, 1995; Grivas, Vasiliadis, & O'Brien, 2008; Karachalios et al., 1999; Morais, Bernier, & Turcotte, 1985; Sabirin et al., 2010).

To complicate matters, the ability to measure the effectiveness and costs of SSS programs is challenging, given that SSS programs are performed in different ways around the world, and even from state to state (Grivas, Vasiliadis, & O'Brien, 2008; Grivas, Wade, et al., 2007). Furthermore, there is no consensus among the experts on the specific criteria that should be utilized for screenings (Grivas, Vasiliadis, & O'Brien, 2008; Grivas, Wade, et al., 2007). Differences among screening protocols, age and gender of the children screened, training provided to school staff, examination techniques used, referral criteria, and interpretation of data all contribute to the difficulty in measuring outcomes in a standardized method (Grivas, Vasiliadis, & O'Brien, 2008; Grivas, Wade, et al., 2007).

The Unites States Preventative Services Task Force in 1996 (USPSTF, 1996) noted that there was insufficient evidence to either recommend or refute routine screenings for AIS. However, after re-analyzing the existing data, they determined in 2004 (USPSTF, 2004) that they officially advised against school screening on the grounds of reasonable evidence of unnecessary brace prescriptions and referrals for specialty care.

Research since 2000 has more consistently demonstrated the significant over-referral rate; however, there remains debate regarding the cost-benefit ratio. More specifically, Yawn and Yawn (2000) conducted a population-based, longitudinal retrospective study of one community's school-based scoliosis screening program. This screening program used the AFB and scoliometer during screenings, and the screening program was supervised by an orthopedic surgeon who worked with the nurses (Yawn & Yawn, 2000). Results showed that 92 (4.1%) of 2197 children screened were referred for further evaluation of possible

scoliosis. Of these 92 children, only 5 were treated for scoliosis by age 19 (5%) (Yawn & Yawn, 2000).

Beausejour et al. (2007) reviewed the clinical and radiological charts of 636 Canadian patients referred for scoliosis evaluation over a one-year period of time at a metropolitan pediatric hospital. Of the 489 suspected AIS cases, 206 (42%) had no significant deformity (Cobb angle ≤10 degrees) (Beausejour et al., 2007). Conversely, in students with confirmed AIS, 91 (32%) were classified as late referrals with regards to brace treatment indications (Beausejour et al., 2007). The authors of this study conclude that the current screening and referral mechanisms used in their system led to a suboptimal case-mix of appropriateness of referrals (Beausejour et al., 2007).

A study by Luk et al. (2010), revealed relatively better results. This study evaluated the school screening program for AIS in Hong Kong (Luk et al., 2010). By following all screened students until the age of 19, they determined that the sensitivity of scoliosis screenings in Hong Kong to be 55.5% for curves ≥ 20 degrees and 51.7% for curves requiring treatment (Luk et al., 2010). They cite specific reasons why their screening process likely results in higher degree of clinical effectiveness than that of other studies, including: 1) the use of moiré topography (a method of contour mapping produced from the overlapping interference fringes created when an object is illuminated by beams of coherent light issuing from two different point sources) as opposed to the use of AFB test alone; 2) the use of a 20 degree cut-off for referral as opposed to 10 degrees in most other screening programs; 3) students were screened by trained physicians and registered nurses, who were more skilled and experienced than the non-professionals who carry out most other screening programs

(Luk et al., 2010). However, it should be noted that with these more refined screening procedures, the cost of screening is likely to increase.

Fong et al. (2010) completed a meta-analysis that systematically reviewed 36 evaluation studies of school scoliosis screening programs. Based on meta-analysis, they determined that the pooled referral rate for radiography was 5%, and the pooled positive predictive value (PPV) for detecting curves ≥10 degrees, curves ≥20 degrees, and curves requiring treatment were 28%, 5.6%, and 2.6%, respectively (Fong et al., 2010). They further concluded that programs that only utilized a forward bending test (as does Texas's SSS program) as their screening instrument, had a higher referral rate with a lower precision in detecting scoliotic curves (Fong et al., 2010).

Cost Analysis of SSS Programs

As indicated previously, general effectiveness of SSS programs are difficult to assess due to the variance of procedures across programs. This is also true for analyzing cost-effectiveness. Costs per child screened have been estimated in several studies, though a consistent, clear amount remains unknown. Sabirin et al. (2010) completed a systematic review on the cost-effectiveness of SSS programs. Among 28 articles included in the review, there were 6 studies on economic evaluation related to SSS, which were conducted in the US, Canada, Sweden, Greece, and Singapore (Sabirin et al., 2010). The authors discovered that the cost of screening per child ranged from as low as 0.07 USD to as high as 43.7 USD, depending on the cost calculation (Sabirin et al., 2010). Some studies only calculated the costs of the salary

of the screeners, while others included training costs, monitoring, follow-up, diagnostic tests, the treatment of the students, and everything in between (Lee et al., 2010a; Sabirin et al., 2010).

Two studies have calculated the monetary costs for scoliosis from initial screening at school through treatment and follow-up to the age of 19 (Lee et al., 2010a; Yawn & Yawn, 2000). Yawn and Yawn (2000) determined that the total charge associated with screening and pre-treatment scoliosis evaluation was 24.66 USD per child. Lee et al. (2010a)examined the screenings of a cohort of 115,190 fifth graders and estimated the costs spent on screening, diagnosing, following, and treating this cohort. They determined that the costs of the school screening for 1 student was 17.94 USD and the final diagnosis of 1 student was 2.08 USD (Lee et al., 2010a). Of the 1311 referrals who attended the specialist hospitals for diagnosis, 264 and 39 had been braced and operated on, respectively (Lee et al., 2010a). The medical care cost averaged 34.61 USD per student screened (Lee et al., 2010a). The cost of finding 1 student with a curvature $\geq$20° and 1 treated case were 4475.67 USD and 20,768.29 USD respectively (Lee et al., 2010a).

SSS and Anxiety

In addition to the monetary costs of SSS programs, several investigators of SSS programs question other indirect costs. More specifically, they raise the concern that these programs may result in increased anxiety and distress (Grivas, Vasiliadis, et al., 2007; Grivas, Vasiliadis, & O'Brien, 2008; Grivas, Vasiliadis, & Rodopoulos, 2008; Grivas, Wade, et al.,

2007; Kapoor et al., 2008; Lee et al., 2010a, 2010b; Morrissy, 1999; Reamy & Slakey, 2001; Yawn & Yawn, 2000). These authors noted that the high false-positive rate associated with SSS may lead to "anxiety for the parent and child" and result in unnecessary referrals and exposure to ionizing radiation (Kapoor et al., 2008). This notion is mentioned in the literature repeatedly:

> Unnecessary referrals of adolescents who have minimal scoliosis and are at low risk for progression can cause marked anxiety and lost time from school or work, and lead to unnecessary radiation exposure (Reamy & Slakey, 2001).

> Criticism of school screening programs cite mainly the negative impact on children and their parents, because they produce anxiety, inconvenience, radiation exposure from follow-up, school missing for students, and loss of working hours for parents for unnecessary follow up appointment (Grivas, Vasiliadis, et al., 2007).

> The cost calculations include only health care utilization data and do not include indirect costs, such as loss of work and school time or the costs of anxiety about false-positive test results or increased insurance rates that may result for children with preexisting conditions. Therefore, the cost estimates should be considered an underestimate of the total costs of the scoliosis screening program (Yawn & Yawn, 2000).

> In the usual doctor-patient contract, the patient comes to the doctor with a problem and the doctor agrees to do his best to solve the problem. However, in prescriptive screening, it is the medical establishment that has sought the patient. The asymptomatic patient is told they either probably do or probably do not have the disease. If they are a false positive, they are harmed by the anxiety, costs, and possibly unnecessary treatment they are subjected to (Morrissy, 1999).

Through reading these concerns in the literature, it appears that understanding the emotional toll SSS referrals may have on families is an unknown, yet important aspect that requires further investigation. Consequently, no study has systematically examined the SSS program and referral process from a psychological perspective. In fact, one author noted, "The

negativists of school screening implicate the increased indirect cost and the psychological impact on the child, which basically cannot be measured, to criticize these programs" (Grivas, Wade, et al., 2007). This study was designed to objectively measure the anxiety experienced by adolescents and their parents using a reliable and validated measure of situational and characterlogical anxiety.

EFFECTS OF ANXIETY

Prevalence

The prevalence of anxiety symptoms meeting disordered diagnostic criteria is concerning (annual prevalence ranging from 5.7 to 17.7%) (Bernstein, Borchardt, & Perwien, 1996; Bernstein & Shaw, 1997; Cohen et al., 1993; Henker, Whalen, Jamner, & Delfino, 2002). However, subclinical levels of anxiety are an equally concerning prevalence among youths in the general population (Hale, Raaijmakers, Muris, van Hoof, & Meeus, 2008). Investigations of more general worries and specific fears have revealed that children and adolescents report a significant number of pervasive fears and worries that reflect underlying anxiety in more than 20% of healthy school-age children (Hale et al., 2008). An investigation of the clinical significance of these fears discovered that fears were associated with subclinical manifestations of anxiety symptoms in 49% of the children that interfered with children's daily routine (Muris, Merckelbach, Mayer, & Prins, 2000).

There appears to be a preponderance of anxious experiences across the lifespan in females, with girls (ages 6 to 16) in community research reporting higher levels of anxiety

and worry compared to same-age boys (Waters, Zimmer-Gembeck, & Farrell, 2012). Waters et al. (2012) indicated that this gender disparity may in part be explained by pubertal development as early maturing girls experience more anxiety and depressive symptoms over a subsequent four-year period than in normally maturing girls. As pubescent, adolescent girls are the most prevalent population at risk for AIS (and the most prevalent population targeted for school screenings), it may be even more critical to consider their increased risk for the experience of anxiety symptoms.

Consequences and Comorbidities of Anxiety

Woodward and Ferguson (2001) studied an outpatient sample of adolescents and determined that both anxiety and depressive symptoms played a significant role in adolescents' physical complaints. These somatic physical complaints often lead to school refusal or poorer performance at school in general (Woodward & Fergusson, 2001). A study conducted by Henker et al. (2002) used electronic diaries in adolescents with high anxiety levels. Results suggested that highly anxious teenagers reported both higher levels of anxiety and stress, and higher levels of sadness, fatigue, and anger. Furthermore, they observed that anxious teenagers disengaged from socially constructive behaviors (e.g., fewer conversations with friends, non participation in recreational activities) and engaged in socially deconstructive behaviors (e.g., increased binge eating, increased smoking) (Henker et al., 2002).

Various factors may influence the development and maintenance of anxiety in youth including both vulnerability factors (including temperament, cognitive style, female gender,

age) and environmental factors (especially the role of parents and external/situational stressors) (Waters et al., 2012). For the present study's population (mostly adolescent, pubescent, females), it may be important to consider the innate vulnerability factors of age and gender, as well as the school screening process and referral to an orthopedic surgeon for scoliotic evaluation as a potential external stressor. Additionally, it has been determined that anxious individuals are more likely to interpret ambiguous and mildly threatening stimuli as overly dangerous and threatening compared to non-anxious peers (Waters et al., 2012). Students who are more vulnerable to experiencing anxiety may be more likely to overestimate the danger/threat posed by a routine school screening or standard scoliosis evaluation.

Anxiety in Healthcare Settings

Research on the role of anxiety experienced by patients within a healthcare setting have also provided relevant findings to this study. Court et al. (2009a) report that anxiety in the healthcare setting has been associated with disrupted recall of information, poor attention, reduced satisfaction, poor patient-doctor communication, patient non-compliance and non-attendance of appointments.

Court et al. (2009a) shared that the patient's subjective thoughts and expectations determined if a situation was considered a "threat." Typically, if an individual believed that a situation would lead to personal negative outcomes, it was more likely to be identified as a "threat." Within primary healthcare, the commonly identified "threats" that increase anxiety

include the expectancies of pain, embarrassment of sharing personal information, loss of patient autonomy, lack of control, and receiving bad news (Court, Greenland, & Margrain, 2009b). These particular "threats" are likely similar to the orthopedic setting. Court et al. (2009a) further explained that two forms of anxiety, trait and state, may be influenced within the healthcare setting. Trait anxiety is a stable personality trait that is more characteristic of a person, which influences a person's "anxiety proneness." State anxiety is a temporary experience caused by a specific, perceived "threat" (Court et al., 2009b). They posit that state anxiety is thus reactive to the healthcare experience (Court et al., 2009b).

Parental Anxiety

Familial influence on child and adolescent anxiety symptomatology is also an important factor to consider. Adolescents with high levels of anxiety symptoms were found to report more family "chaos," less autonomy and openness, less intimacy/warmth in their families, and parents who may be more controlling and overprotective (Prange et al., 1992; Woodward & Fergusson, 2001). The effect of anxiety on parental functioning has become of increasing interest in psychological research (Murray et al., 2012).

Parents are determined to have an influential impact on the origins and maintenance of anxiety within children, and parental anxiety is a significant risk factor for the presence of child anxiety (Waters et al., 2012). Paternal and maternal anxiety appears to equally influence risk for childhood anxiety; however, mothers are more likely to be anxious themselves than fathers, as is consistent with anxiety preponderance in females across the

lifespan (Waters et al., 2012). Genetic heritability is thought to account for approximately 30% of the variance in the transmission of anxiety to children from parents. Other mechanisms have been suggested, including social learning/modeling, reinforcement of anxious responses in children, and transmission of threat-related information (Waters et al., 2012). Further, it is thought that there is a reciprocal interplay between parental and child anxiety, in that anxiety in the child may exacerbate anxiety in the parents, who then adjust demands, expectations and parenting practices to cope with this distress (Waters et al., 2012). This in turn negatively reinforces and maintains anxious behaviors in the child (Waters et al., 2012). Acknowledging this interplay within the context of the current study may be important to understanding the results and assisting in the development of suggestions for improvements to the SSS referral processes and treatments received at orthopedic evaluations.

CHAPTER THREE
Aims and Hypothesis

OVERALL AIM

The overall aim of the present study was to objectively assess, with a psychometrically sound measure, the current levels of anxiety experienced by adolescents and parents at the time of orthopedic evaluation for adolescent idiopathic scoliosis (AIS) after referral through the Texas School Scoliosis Screening program.

Aim One

To assess if School Scoliosis Screening (SSS) programs induce more than expected levels of anxiety in parents and/or children when the child does not meet diagnostic criteria for idiopathic scoliosis after orthopedic evaluation.

Hypothesis 1

Children in the patient group will demonstrate significantly elevated levels of state-anxiety upon arrival to the hospital compared to those in the control group.

Hypothesis 2

Parents in the patient group will demonstrate significantly elevated levels of state-anxiety upon arrival to the hospital compared to those in the control group.

Hypothesis 3

Children in the patient group will demonstrate a significant decrease in state-anxiety levels after completion of their scoliosis evaluation when they are determined to not have scoliosis as compared to 1) patients who do receive scoliosis diagnosis, and 2) control group whose state-anxiety levels will remain constant.

Hypothesis 4

Parents in the patient group will demonstrate a significant decrease in state-anxiety levels after completion of the scoliosis evaluation when their children are determined to not have scoliosis as compared to 1) parents whose children do receive scoliosis diagnosis and, 2) control group whose state-anxiety levels will remain constant.

Aim Two

To add to the existing literature on the costs/benefits of SSS based on the percentage of false-positive referrals produced from current SSS methods, and to determine family satisfaction with the School Scoliosis Screening process and referral experience to TSRHC.

Hypothesis 5

Consistent with findings in other institutions, there will be a significant number of false-positive scoliosis evaluation referrals to TSRHC.

Hypothesis 6

These false-positives will show lower levels of satisfaction with the type and amount of information provided by their school regarding the SSS referral process.

Exploratory Aim

Report parent financial burden and lost time from school or work by the families as a part of the school screening referral process.

CHAPTER FOUR
Methodology

DESIGN

This study was a cross-sequential design utilizing newly collected data at Texas Scottish Rite Hospital for Children (TSRHC; Dallas, TX). The study consisted of two groups – a patient group of patients from TSRHC and a healthy control group between the ages of 9 and 17. One parent/legal guardian per participant also participated in the study. All participants and parents/legal guardians in the study completed the primary outcome measure (State-Trait Anxiety Inventory) at two time points – before and after scoliosis evaluation for the patient group, and before and after a controlled wait period for the control group. Informed consent procedures, pre-administration of the self-report forms, and post-administration of the self-report forms were conducted by the same administrator for consistency. During the wait period, the control group participants waited at the Psychology Department waiting room or in one of the psychology department offices.

PARTICIPANTS

This study consisted of two groups, a patient group of patients from TSRHC and a healthy control group. The patient group consisted of patients, and one parent/legal guarding per patient, attending TSRHC who were scheduled for a new patient evaluation of scoliosis, and referred as a result of their school's scoliosis screening program. Participants were recruited

through two TSRHC New Patient Scoliosis Clinics on days when study personnel was available. Consecutive participants meeting study inclusion/exclusion criteria in these clinics were enrolled during recruitment periods. No participants who met study inclusion/exclusion criteria who were approached for study refused participation in the study; however, one participant consented and then did not complete study participation. This participant also did not complete their scoliosis evaluation. Due to incomplete study and evaluation data, this participant was excluded from data analysis.

The healthy control volunteers were recruited from the community and/or hospital junior volunteer program. The Hospital's Volunteer Services department assisted in identifying healthy control participants. These participants were contacted via phone or during the hospital orientation to request volunteer participation in this research study. Additionally, study patient participants were asked to provide information about this research study to their school friends/associates via a flyer with study details.

Twenty-seven adolescents (and 27 parents/legal guardians) (10 males and 17 females) between the ages of 9 and 17 completed the study procedures from the TSRHC patient group. Seventeen adolescents (and 17 parents/legal guardians) (2 males and 15 females) between the ages of 9 and 17 completed the study procedures from the healthy control group. Enrollment for study participation ran from time of study IRB approval (August 2013) until April 2014

All participants in the study were required to read and write English, due to the lack of personnel available for interpretation as well as lack of validated study forms available in other languages (e.g., Spanish). The study was approved by the appropriate Institutional Review Board at UT Southwestern Medical Center (IRB#: STU 052013-012). Participating

parents/legal guardians provided written informed consent and adolescents gave written assent. Parent authorization provided access to adolescents' medical records to obtain pertinent scoliosis evaluation information.

Inclusion Criteria

Patient group

1) Child participants are between the ages of 9 and 17; 2) Initial scoliosis screening referral received from the child's school screening process; 3) Child is otherwise medically healthy; 4) Child is considered a new patient to TSRHC.

Healthy Control Group

1) Child participants are between the ages of 9 and 17; 2) Child is otherwise medically healthy.

Exclusion Criteria

Patient group

1) Child is a previous patient of TSRHC; 2) Child and/or parent has previous or current psychiatric diagnosis; 3) Child has history of hospitalization or surgical procedures; 4) Parent(s) work at or are affiliated with TSRHC; 5) Referred by source other than SSS (i.e. through another medical provider).

Healthy Control Group

1) Child is a previous patient of TSRHC; 2) Child and/or parent has previous or current psychiatric diagnosis; 3) Child has history of hospitalization or surgical procedures; 4) Child received positive results at their school scoliosis screening; 5) Child has a history of positive scoliosis findings; 6) Parent(s) work at or are affiliated with TSRHC.

PROCEDURES

Patient Group

Upon check-in at TSRHC, families were asked about their interest in participation in this research study. For those who indicated interest, the Study Coordinator or Principal Investigator (PI) met with the family to obtain informed consent. Prior to any evaluation or medical procedure (including x-ray), the parent/legal guardian completed two data collection forms (demographic form and State-Trait Anxiety Inventory). The patient completed only one data collection form (State-Trait Anxiety Inventory (STAI)). The family then proceeded with the standard scoliosis evaluation clinic visit. After completion of the clinic visit, the parent/legal guardian and child again completed the STAI. The parent/legal guardian also completed a questionnaire about his/her experience with the school screening and referral process, the TSRHC clinic visit, and his/her previous experience with scoliosis (e.g., Did the family do any research on scoliosis before their appointment?).

The PI of the study accessed the patient's medical records after completion of the clinic evaluation to record information documented by the medical team regarding the patient's scoliosis evaluation.

Healthy Control Group

During recruitment, healthy control volunteers completed a one-page screening form to ensure they have no medical or psychiatric history. Upon arrival to the hospital for research study participation, the family met with the Research Study Coordinator or PI to obtain informed consent. The parent/legal guardian completed two data collection forms (demographic form and STAI). The participant completed only one data collection form (STAI). The family was then asked to participate in approximately 30 minutes of independent wait time at the hospital before completing follow-up forms. This wait time was used to mimic the time of the clinical scoliosis evaluation and hospital environment experience of the patient group. At the completion of the wait period, the parent/legal guardian and adolescent completed the STAI.

MEASURES

Copies of all measures utilized in this research can be found in Appendix A.

State-Trait Anxiety Inventory (STAI)

Description

The STAI (Spielberger, 1983) is a 40-item self-report questionnaire designed to measure the presence and severity of current/acute anxiety symptoms as well as a generalized propensity of anxiety (Julian, 2011). Two versions were utilized for this study; the STAI-C for children 13 years of age and younger and the STAI-Y for adolescents and adults (ages 14 and older). The STAI has two subscales, each comprised of 20 items– the State Anxiety Scale and the Trait Anxiety Scale. The State subscale evaluates the current state of anxiety, asking respondents to rate how they are feeling "right now" by utilizing items that measure subjective feelings of apprehension, tension, nervousness, worry, and physical symptoms of anxiety (Julian, 2011). The Trait subscale assesses "anxiety proneness" by evaluating general states of calmness, confidence, and security (Julian, 2011).

The STAI was first published in 1973 (Spielberger, 1973) with the STAI-X, and the current version was revised in 1983 (Spielberger, 1983) (STAI-Y) (Julian, 2011). The STAI was chosen specifically for this study due to its excellent psychometric properties (Hishinuma et al., 2001; Julian, 2011; Ramanaiah, Franzen, & Schill, 1983; Rojas-Carrasco, 2010; Seligman, Ollendick, Langley, & Baldacci, 2004), ability to distinguish between state and trait anxiety (Ramanaiah et al., 1983; Rojas-Carrasco, 2010; Seligman et al., 2004),

ability to be used in test-retest study designs (Layton, 1986; Rule & Traver, 1983), and effective and efficient use within medical populations, particularly those with musculoskeletal conditions (Julian, 2011; Rojas-Carrasco, 2010; VanDyke et al., 2004; Ward, Marx, & Barry, 2002; White, Nielson, Harth, Ostbye, & Speechley, 2002).

Administration and Scoring

The STAI is administered for this study in paper and pencil format. Specific instructions are provided for each subscale (State-Anxiety and Trait-Anxiety); however, verbal instructions were provided to all participants in the study to ensure appropriate completion of the measure. Administration time is approximately 10 minutes for both versions of the measure. Items 1 through 20 are summed to produce a total State-Anxiety score, and items 21-40 are summed to produce a total Trait-Anxiety score. All items are summed to produce a Total Anxiety score. Several items that are "anxiety-absent" are reverse scored (Julian, 2011).

The range of raw scores for each subscale on the child version is 20 to 60, and the adolescent/adult version is 20 to 80. Higher scores indicate greater anxiety (Julian, 2011). Standard T-scores are calculated using normative samples in the STAI manual.

Psychometric Properties

Internal consistency alpha coefficients are high, ranging from .86 to .95 in the adolescent/adult normed samples (Spielberger, 1983). More than 10,000 adults and adolescents were tested during the development of the adolescent/adult version (Spielberger, 1983). Items were selected based on strong associations with other anxiety measures

including the Taylor Manifest Anxiety Scale (J. A. Taylor, 1953) and the Institute for Personality and Ability Testing (IPAT) Anxiety Scale (Cattell, 1963) (Spielberger, 1983). Content validity correlations between the STAI and these measures were .73 and .85, respectively. However, construct validity of the STAI-Trait Anxiety subscale was found to be somewhat limited in discriminating anxiety from general negative affect (Bados, Gomez-Benito, & Balaguer, 2010). Test-retest reliability of the State-Anxiety scale decreases with longer intervals of time between administrations. This is expected, as the scale was designed to measure "transitory conditions of perceived apprehension and tension" (Layton, 1986, p. 586). The STAI is therefore appropriate for use in this study, as the test-retest time is short (approximately 30 minutes) and a sensitive measure of transitory states is required.

For the STAI child version, the internal reliability of the State-Anxiety subscale was .82 and .87 for males and females, respectively (Spielberger, 1973). For the Trait-Anxiety subscale, the alpha coefficients were .78 and .81 for males and females respectively (Spielberger, 1973). Evidence of the concurrent validity of the Trait-Anxiety subscale was determined by its correlation with the Children's Manifest Anxiety Scale (CMAS) (Castaneda, 1956) and the General Anxiety Scale for Children (GASC) (Sarason, 1960) (Spielberger, 1973). In a sample of 75 children, the STAI-child version correlated .75 with the CMAS and .63 with the GASC (Spielberger, 1973). These psychometric results were later confirmed in a study that compared the STAI to the CMAS and Child Behavior Checklist (CBCL) (Seligman et al., 2004).

Demographic Information

The following demographic and socioeconomic information were obtained from patients' and healthy controls' parents/legal guardians: adolescent's date of birth, age in years, gender, race, education type (i.e., public, private, or home school), grade level, living arrangement, who is fulfilling the role of the child's primary caretaker (i.e., biological parent, adoptive parent, other relative, etc.), parental/guardian's age, educational status, employment status, number of people living in the home, and the family's estimated yearly income. Parent/guardian education and occupation status was then used to derive the family's SES.

Experience Questionnaire

Parents/legal guardians completed an experience questionnaire developed by the PI of the study to assess certain aspects of the referral process. The questions addressed the family's satisfaction with services received from their school and TSRHC, length of time between school referral and TSRHC appointment, monetary costs and lost time from school/work due to evaluation procedure, and identify prior knowledge or experience with scoliosis. Additionally, this questionnaire addressed presence of back pain and management thereof, and prior medical and psychological history and treatment of both parent and child.

Medical Records Evaluation Information

After the patient's scoliosis evaluation, the PI of the study reviewed the medical team's records to collect the following pertinent information: the patient's measured Cobb angle at this visit, if the patient meets diagnostic criteria for AIS, the suggested course of treatment, if and when a follow-up appointment was scheduled, reports of back pain and management thereof, and any limitations in activities due to the patient's back.

DATA ANALYSIS

Data Collection Procedures

All data was housed in locked filing cabinets within a locked office and locked department to protect patient confidentiality and data. The PI entered participant data into the statistical database utilizing IBM's® Statistical Package for the Social Sciences (SPSS®) program (version 22). Power analysis was completed using the first 10 patient participants and first 10 healthy control participants using the software program Power and Precision™ (version 4).

Data Analysis Procedures

An initial power analysis was completed with the state-anxiety means from each group (patient and healthy control) collected at the beginning of data collection. Based on this preliminary analysis, with a sample of 17 participants per group, the study was determined to

have power of 80% for the primary outcome measure (STAI-State Anxiety between groups). This means that there is an 80% likelihood that the study will yield a statistically significant effect, and allow us to conclude that the mean State Anxiety total score at baseline differs between patients and healthy controls. This preliminary power analysis appeared positive and suggested that a sufficient sample size would be 17 subjects per group. However, to increase power and minimize chances of error, continued recruitment was pursued within the established timeline, with 27 subjects per group enrolled, for a total sample size of 54 subjects.

All but one participant, in the patient group, completed the data collection forms in total. Therefore, one consented participant was excluded from the data set all together. This left a remainder of 27 participants with complete data collection in each group. As such, no protocol was necessary to examine missing data.

CHAPTER FIVE
RESULTS

DEMOGRAPHICS AND CLINICAL CHARACTERISTICS

Demographic Characteristics

The sample of participants in this study consisted of 108 total participants (54 children and 54 parents). The sample was comprised of 27 children (and corresponding parent) in the patient group and 27 children (and corresponding parent) in the healthy control group. The study sample in both groups was limited to children between ages 9 and 17 (inclusive). The mean sample age of children in the patient group was 13.4, and the mean age for the control group was 14.1. The patient group consisted of 10 (37%) males and 17 (63%) females; while the control group consisted of 7 (26%) males and 20 (74%) females. The parental gender for the patient group was 6 (22%) fathers and 21 (78%) mothers. The parental gender for the control group was 5 (19%) fathers and 22 (81%) mothers.

The patient group consisted of 13 (48.1%) Caucasian participants, 2 (7.4%) African American participants, 2 (7.4%) Asian participants, 1 (3.7%) American Indian participants, 6 (22.2%) Hispanic/Latino participants, and 3 (11.1%) other ethnicities. The control group consisted of 14 (51.9%) Caucasian participants, 1 (3.7%) African American participants, 6 (22.2%) Asian participants, 4 (14.8%) Hispanic/Latino participants, and 2 (7.4%) other ethnicities. Socio-economic status (SES) was assessed by parent(s) education and current

occupational status. Within the patient group, over half (55.6%) of the participants comprised the highest level of SES. Participants in the control group also mostly comprised the highest level of SES (70.4%).

Participants in the patient group clustered between 5th through 11th grade, with the mode of patients in the 7th grade (7 patients, 25.9%). Participants in the control were more scattered between the 3rd and 12th grades, with the mode of controls in the 10th grade (6 controls, 22.2%). See Table 1 for a summary of sample demographic characteristics.

Clinical Characteristics

All participants were screened for the presence of a mental health diagnosis or previous experience with surgery/hospitalization. In the patient group, 24 (88.9%) patients denied having a mental health diagnosis, while 3 (11.1%) endorsed a mental health diagnosis of Attention-Deficit Hyperactivity Disorder (ADHD). Similarly, the control group consisted of 26 (96.3%) controls that denied having a mental health diagnosis, while 1 (3.7%) endorsed a diagnosis of ADHD.

Regarding previous experience with surgery or hospitalization, 3 (11.1%) participants in the control group reported a positive history of surgery. Of these surgeries, two were for tonsillectomy and adenoidectomy and the third was for the removal of an ingrown toenail. No participants in the control group endorsed previous surgical or hospital experience. See Table 2 for a summary of sample clinical characteristics.

Evaluation of Study Differences

The distributions of the data were examined for normality and outliers to ensure that assumptions were met for the statistical analyses. The data were normally distributed; therefore, the data required no statistical transformations. Additionally, Chi-square ($\chi 2$) tests for frequency variables and independent samples t-tests were performed on the demographic variables to determine whether these variables should be controlled for in the analyses. There were no significant differences between the patient and control groups with respect to gender ($\chi 2$ (1) =0.77, p=0.38), race ($\chi 2$ (5) =3.97, p=0.55), grade level ($\chi 2$ (9) =9.81, p=0.37), parent-child gender relationship ($\chi 2$ (1) =0.67, p=0.41), or SES ($\chi 2$ (4) =9.14, p=0.06). There was no significant difference in age between the patient (M=13.69, SE=0.50) and control groups (M=14.07, SE=0.43; t (38) =-0.54, p=0.50, CI:-1.81-1.05). See Table 1 for a summary of sample demographic characteristics.

AIM ONE

To assess if School Scoliosis Screening (SSS) programs induce more than expected levels of anxiety in parents and/or children when the child does not meet diagnostic criteria for adolescent idiopathic scoliosis after orthopedic evaluation.

Hypothesis 1

Children in the patient group will demonstrate significantly elevated levels of state-anxiety upon arrival to the hospital compared to those in the control group.

Analysis

Independent samples t-tests were used to compare state-anxiety (STAI State Scaled Score) at time 1 (beginning of hospital appointment (pre)) among patients and controls. The Levene's Test for Equality of Variances was used to test for the homogeneity of group variances. The test was not significant, F (52) =0.008, p=0.93; therefore, results reported assumed equal variances. Children in the patient group (M=45.74, SE=1.56) demonstrated significantly elevated levels of state-anxiety upon arrival to the hospital compared to those in the control group (M=41.07, SE=1.59; t (52) =2.10, p=0.04, CI: 0.20-9.14). This result is consistent with the hypothesis that children in the patient group would experience significantly elevated levels of state-anxiety upon arrival to the hospital compared to those in the control group. The mean T-score of 45.7 for the patient group state-anxiety suggested an average level of anxiety upon arrival to the hospital for scoliosis evaluation, though this still remained statistically higher than the control group with a below-average level of anxiety at a mean T-score of 41.1. See Table 3 for a summary of hypothesis 1.

Hypothesis 2

Parents in the patient group will demonstrate significantly elevated levels of state-anxiety upon arrival to the hospital compared to those in the control group.

Analysis

Independent samples t-tests were used to compare state-anxiety (STAI State Total Score) at time 1 (beginning of hospital appointment (pre)) among parents of patients relative to those of controls. The Levene's Test for Equality of Variances was significant, F (52) =9.67, p=0.003; therefore, results reported assumed unequal variances. As such, the SPSS modified t-test that accounted for groups of unequal variances is reported. Parents in the patient group (M=47.5, SE=1.70) demonstrated significantly elevated levels of state-anxiety upon arrival to the hospital compared to those in the control group (M=42.56, SE=1.10; t (44.43) =2.43, p=0.02, CI: 0.85-9.01). These results are consistent with the hypothesis that parents in the patient group demonstrated higher levels of state anxiety upon arrival to the hospital compared to the control group parents. The mean T-score of 47.48 for the patient group state-anxiety suggested an average level of anxiety upon arrival to the hospital for scoliosis evaluation. This still remains statistically higher than the control group with a below-average level of anxiety at a mean T-score of 42.6. See Table 4 for a summary of hypothesis 2.

Hypothesis 3

Children in the patient group will demonstrate a significant decrease in state-anxiety levels after completion of their scoliosis evaluation when they are determined to not have scoliosis as compared to 1) patients who do receive scoliosis diagnosis, and 2) control group whose state-anxiety levels will remain constant.

Analysis

Repeated Analysis of Covariance (ANCOVA) examined the differences between two or more independent groups over time controlling for potential confounding variables. In this case, repeated ANCOVA were used to compare pre and post state-anxiety total scores among three groups (patients with no AIS diagnosis, patients with AIS diagnosis, and healthy controls). The covariate of trait-anxiety was used to control for potential confounding of characterlogical anxiety. The Box's Test of Equality of Variances examined the assumption that the dependent variable (state-anxiety) had approximately homogenous variance-covariance matrices. The Box's Test of Equality of Variances was significant (p=0.001). Therefore, Hotelling's Trace was used to determine the differences in the multivariate analyses. There was a significant main effect for time, *Hotelling's Trace*=0.17, F (1, 50) =8.49, p=0.005, $\eta 2$=0.15, *power*=0.82, and a significant interaction between time and group, *Hotelling's Trace*=0.45, F (2, 50) =11.2, p=0.00, $\eta 2$=0.31, *power*=0.99. It should be noted that the effect size ($\eta 2$) for both these findings were considered large. Effect size values ranged from 0 to 1, and a value of 0 indicated that there were no differences in the mean

scores among groups, whereas a value of 1 indicated the strongest possible relationship. Generally, an $\eta 2$ .01, .06, and .14 are interpreted as small, medium, and large effect sizes, respectively. There was not a significant main effect for group, F (2, 50) =1.47, p=0.24, $\eta 2$=0.06, *power*=0.30.

There was a significant decrease in state-anxiety from baseline/pre (*MM*=44.21, *SE*=1.00) to post (*MM*=39.71, *SE*=1.16), p=0.00, for all participants. Participants in the patient group who did not receive a scoliosis diagnosis showed a significant decrease in state-anxiety from baseline/pre (*MM*=46.16, *SE*=1.87) to post (*MM*=35.72, *SE*=2.16), p=0.00, as hypothesized. Participants in the patient group who received a diagnosis of scoliosis did not show a significant decline in state-anxiety from baseline/pre (*MM*=45.46, *SE*=1.94) to post (*MM*=43.34, *SE*=2.24), p=0.23, as hypothesized. Participants in the control group also did not show a significant change in state-anxiety from baseline/pre (*MM*=40.99, *SE*=1.35) to post (*MM*=40.06, *SE*=1.55), p=0.44, as hypothesized. Additionally, participants in the patient group who received a diagnosis of scoliosis (*MM*=43.34, *SE*=2.24) showed significantly higher levels of state-anxiety following their scoliosis screening evaluation (post) than patients who did not receive a diagnosis of scoliosis (*MM*=35.72, *SE*=2.16), p=0.054, as hypothesized. There were no significant differences in state-anxiety at post for healthy controls (*MM*=40.06, *SE*=1.55) compared to participants who were diagnosed with scoliosis (p=0.70), nor compared to patients who were not diagnosed with scoliosis (p=0.31). See Figure 5 for graphical representation of these results. See Table 5 for a summary of hypothesis 3.

Hypothesis 4

Parents in the patient group will demonstrate a significant decrease in state-anxiety levels after completion of the scoliosis evaluation when their children are determined to not have scoliosis as compared to 1) parents whose children do receive scoliosis diagnosis, and 2) control group whose state-anxiety levels will remain constant.

Analysis

Repeated measures ANCOVA examined the differences between two or more independent groups over time. In this case, repeated ANCOVA were used to compare pre and post state-anxiety total scores among three groups (parents of patients with no AIS diagnosis, parents of patients with AIS diagnosis, and parents of healthy controls). The covariate of trait-anxiety was used to control for potential confounding of characterlogical anxiety. The Box's Test of Equality of Variances was significant (p=0.00). Therefore, Hotelling's Trace was used to determine the differences in the multivariate analyses. There was not a significant main effect for time, *Hotelling's Trace*=0.01, F (1, 50) =.319, p=0.56, η^2=0.01, *power*=0.09. There was not a significant main effect for group, F (2, 50) =1.47, p=0.24, η^2=0.06, *power*=0.29, nor a significant interaction effect for time and group, *Hotelling's Trace*=0.03, F (2, 50) =0.85, p=0.44, η^2=0.03, *power*=0.19.

There was a significant decrease in state-anxiety for all parents (as a group) from baseline/pre (*MM*=45.51, *SE*=0.77) to post (*MM*=43.22, *SE*=0.98), p=0.02. Parents in the patient group whose children were determined not to have scoliosis showed a significant

decline in state-anxiety from baseline/pre (*MM*=46.27, *SE*=1.43) to post *(MM*=42.27, *SE*=1.85), *p*=0.03, as hypothesized. Parents in the patient group whose children received a scoliosis diagnosis did not show a significant decline in state-anxiety from baseline/pre (*MM*=46.70, *SE*=1.50) to post (*MM*=45.15, *SE*=1.90), *p*=0.39, as hypothesized. Parents in the control group also did not show a significant change in state-anxiety from baseline/pre (*MM*=43.56, *SE*=1.04) to post (*MM*=42.24, *SE*=1.32), *p*=0.30, as hypothesized. See Figure 6 for graphical representation of these results. See Table 6 for a summary of hypothesis 4.

AIM TWO

To add to the existing literature on the costs/benefits of SSS based on the percentage of false-positive referrals produced from current SSS methods, and to determine family satisfaction with the School Scoliosis Screening process and referral experience to TSRHC.

Hypothesis 5

Consistent with findings in other institutions, there will be a significant number of false-positive scoliosis evaluation referrals to TSRHC.

Analysis

Percentages were calculated to determine rates of false-positive referrals. Of the children who were referred by their school screening to the TSRHC for additional evaluation of scoliosis during the course of study recruitment, 27 agreed to participate in this study. Of

these 27 participants, 14 (51.9%) were negative for AIS (over half false-positive referrals). Thirteen (48.1%) participants were determined to have scoliosis following their orthopedic evaluation.

Those in the false-positive group had a mean age of 13.07 (*SE*=0.50) and the true-positive group had a similar mean age of 13.69 (*SE*=0.49). The false-positive group consisted of 7 (50%) males and 7 (50%) females, while the true-positive group had 3 (23%) males and 10 (77%) females.

Of those 13 positive for scoliosis, 4 (30.8%) were determined to have curves measuring between 10 to 19 degrees, a minimal Cobb angle likely resulting in clinical observation rather than significant medical intervention. Seven (53.8%) of the participants' curves measured between 20 and 29 degrees, which is considered to be a mild Cobb angle unlikely to progress at bone maturity. One (7.7%) participant had a curve between 30 and 39 degrees, which is a moderate Cobb angle that may warrant orthotic treatment. One (7.7%) participant had a curve between 40 and 49 degrees, also a moderate Cobb angle, which may warrant surgical intervention.

As expected, all 14 (100%) participants in the false-positive group did not require treatment of any kind. At the time of evaluation, the true-positive group consisted of 7 (53.8%) requiring no treatment recommendations, 3 (23.1%) requiring bracing treatment, and 3 (23.1%) requiring observation/monitoring of the curve. At the time of the study, no participants were recommended with surgical treatment. See Table 2 for a summary of Cobb angle distribution. See Table 7 for a summary of hypothesis 5.

Hypothesis 6

These false-positives will show lower levels of satisfaction with the type and amount of information provided by their school regarding the SSS referral process.

Analysis

Descriptive analyses were produced for all variables, including frequencies and percentages for categorical variables. There were no significant differences between the false-positive participants (no AIS diagnosis) and the true-positive participants (AIS diagnosis) on whether their school provided information on scoliosis evaluations ($\chi 2$ (1) =0.90, p=0.34), the type of information they received from the school ($\chi 2$ (4) =5.01, p=0.29), whether the information adequately addressed their concerns or questions ($\chi 2$ (3) =3.10, p=0.38), or whether they found the information helpful ($\chi 2$ (3) =0.36, p=0.95). Therefore, both groups reported similar experiences with the amount and type of information received from the school about scoliosis screenings and evaluations.

Further, both groups reported similarly on the helpfulness of this information. School information was provided in a handout/brochure form to 5 out of 14 (35.7%) participants in the false-positive group, and 7 out of 13 (53.8%) in the true-positive group. Less than half of the group as a whole received any information from the school (44.4%). Of those who received information in the false-positive group, 4 out of 5 (28.6%) found that the information was helpful and one out of the 5 (7.1%) found the unhelpful. Of those who received information in the true-positive group, 5 out of 7 (38.5%) found that the information

was helpful, one (7.7%) found the information unhelpful, and one (7.7%) was unsure of the helpfulness. These findings do not support the hypothesis that the false-positive group would report lower levels of satisfaction with the type and amount of information provided by their school. It appeared that both groups reported low percentages in the actual receipt of information obtained, though in both groups, when information was obtained, the participants found that information helpful.

There were also no significant differences between the false-positive participants and the true-positive participants on whether they did any research on scoliosis prior to their appointment ($\chi 2$ (1) =2.10, p=0.15), where they looked for that information ($\chi 2$ (4) =4.19, p=0.38), how this information made them feel ($\chi 2$ (3) =4.64, p=0.20), or whether the parents had discussed their appointment with their child ($\chi 2$ (3) =0.48, p=0.92). Fifty percent (7 out of 14) of the false-positive participants did their own research on scoliosis prior to their evaluation at TSRHC, while 77 percent (10 out of 13) in the true-positive group did their own research prior to their appointment. Both groups reported using the Internet, talking to other medical professionals, or talking with scoliosis patients as sources. Five out of 7 (71.4%) in the false-positive group report feeling more concerned about their evaluation after doing their own research, while 4 out of 10 (40%) in the true-positive group report feeling more concerned. Twelve (86%) in the false-positive group and 12 (92%) in the true-positive group reported that they discussed the evaluation with their child prior to the appointment.

There were also no significant differences between the false-positive participants and the true-positive participants on whether the parents found their child's SSS evaluation beneficial ($\chi 2$ (2) =2.01, p=0.37), whether the parents found their child's evaluation at

TSRHC beneficial, the comfort level with the TSRHC team ($\chi 2$ (1) =0.02, p=0.88), or whether a follow-up appointment was scheduled ($\chi 2$ (1) =1.85, p=0.17). Ten out of 14 (71.4%) false-positive participants found the SSS evaluation process helpful, as did 11 out of 13 (84.6%) true-positive participants. All participants in both groups reported that their TSRHC appointment was beneficial.

The true-positive participants showed higher levels of treatments (i.e. bracing or surgery) than the false-positive participants ($\chi 2$ (2) =8.31, p=0.02), as was expected. No treatments were prescribed for all 14 participants in the false-positive group. Seven of the 13 (53.8%) true-positive participants required no treatment. Orthotic bracing was prescribed for 3 (23.1%) of the true-positive participants, and observation/monitoring was prescribed for 3 (23.1%) of the true-positive participants. No participants in this study were prescribed surgical intervention. Additionally, true-positive participants (M=23.69, SE=2.32) showed significantly higher Cobb angles at the evaluation than false-positive participants (M=4.07, SE=1.34; t (25)=7.45, p=0.00, CI: 14.20-25.04), as expected given their positive diagnosis. See Table 8 for a summary of hypothesis 6.

EXPLORATORY AIM

Report parent financial burden and lost time from school or work by the families as a part of the school screening referral process.

Analysis

Descriptive analyses were produced for all variables. Parent reported financial burden associated with the SSS referral process and TSRHC evaluation was an average of $467.56 (*SE*= 368.90). Families reported missing a mean of .74 (*SE*=.20) school days and .44 (*SE*=.20) work days.

CHAPTER SIX
Conclusions and Recommendations

STUDY FINDINGS

The present study investigated the impact of School Scoliosis Screening (SSS) programs on the level of anxiety and overall experience of the referral process for families. Though the literature on SSS programs articulates a concern for the psychological experience of families being inappropriately referred, no study to date has objectively measured anxiety nor satisfaction of families. Based on the anecdotal concerns of researchers, legislators, and medical professionals participating in SSS referrals, the hypotheses of this study predicted that children and parents who were referred through the school screening programs would exhibit higher levels of state-anxiety at the start of their hospital appointment than those in a healthy control group. It was also hypothesized that the parents and children who were cleared of an AIS diagnosis would exhibit a significant decline in their state-anxiety levels, while those who were diagnosed with AIS and the healthy control group would maintain stable state-anxiety levels at the end of the appointment. Finally, this study hypothesized that there would be a high-rate of false-positive referrals through the SSS process and that those deemed to not have an AIS diagnosis would exhibit less satisfaction with the type and amount of information provided to them about scoliosis by their school. The results of this study aimed to inform this referral process and SSS programs' overall benefits and costs to families.

Demographic Characteristics

Participants were categorized into two groups – a patient group comprised of 27 children and 27 corresponding parents, and a healthy control comparison group comprised of 27 children and 27 corresponding parents. Results of the demographic analysis revealed no significant differences between the groups on any demographic variable, including age, child gender, parent gender, ethnicity, SES, or child's grade level. These results suggested homogeneity across groups and therefore any differences found between groups were unlikely to be the result of these particular demographic variables.

Aim 1

The initial aim of this study was to examine if SSS programs induced more than expected levels of anxiety in parents and/or children when the child is deemed to not have an AIS diagnosis after an orthopedic evaluation at TSRHC. The results suggested that both children and parents in the patient group did experience significantly elevated levels of state-anxiety upon arrival to the hospital relative to those in the control group. This supported the subjective concerns of anxiety experiences in families as voiced by researchers evaluating the effectiveness of SSS programs. The objective measure of situational anxiety through this study revealed that these families were experiencing elevated levels of situational and acute anxiety by being referred to the hospital for scoliosis evaluations when compared to a group of families coming to the same hospital for the same amount of time who were not referred

through the SSS program. Analysis controlled for child and parent trait-anxiety to prevent individual, long-standing, anxiety characteristics from confounding acute/situational anxiety measurements.

Further, this study revealed that the outcome of the AIS evaluation was impactful to these families' experience of state-anxiety. Specifically, all participants in the child groups when viewed as a whole reported a decline in their experience of state-anxiety from the start of their evaluation/appointment to the end of their appointment, regardless of the outcome of the evaluation. This suggested that a certain amount of anticipatory anxiety may be present when patients arrived to the hospital that slightly declined as the children became comfortable with the hospital and/or staff members. The fact that this same pattern occurred in the control group suggested that the change is unlikely attributed to the scoliosis evaluation itself, and may be more likely due to comfort with the environment that was consistent across groups.

When the groups were examined independently, the children and parents in the patient group who were not diagnosed with AIS experienced a significant decline in their state-anxiety from pre to post. However, children and parents in the patient group who were diagnosed with AIS continued to report significantly elevated levels of anxiety). The child and parent control groups also remained consistent in their reported low anxiety levels from the beginning of their appointment to the end of their appointment. These findings supported the intuitive hypothesis that those who complete their hospital appointment/evaluation with no medical diagnosis would experience a decrease in anxiety, while those who are

anticipating an AIS diagnosis and do receive that diagnosis would continue to experience elevated anxiety.

Overall, the initial aim of this study revealed that children and parents of SSS referrals both experienced elevated levels of anxiety upon arrival to the hospital for scoliosis evaluation when compared to healthy control groups. These anxiety levels significantly declined when the child is determined to not have AIS, suggesting that these children and parents experienced heightened state-anxiety despite not being diagnosed.

Aim 2

The secondary aim of this study was to add to the existing literature on the costs and benefits of the SSS programs based on the percentages of false-positive referrals to TSRHC and an evaluation of family satisfaction with the SSS referral process. A literature review revealed high rates of false-positive referrals through SSS programs across the world. Yawn and Yawn (2000) discovered that only 5% of those referred had curves that required treatment. Beausejour et al. (2007) reported false-positive referrals at 42% (curves $\leq$10 degrees) and Luk et al. (2010) reported false-positive referrals at 48.3%. Fong et al. (2010) used a meta-analysis to examine 36 SSS programs, and found a pooled value of false-positive referrals at a high 72% for curves $\leq$10 degrees. Results of this study, as hypothesized, revealed similarly high false-positive referral rates at 52% referred who were negative for an AIS diagnosis. Further, only 22% of those referred required treatment at the time of evaluation (including

bracing or observation). No participants required surgical intervention during their participation in the study.

Similar to previous authors, these high rates of false-positive referrals combined with the objective measure of state-anxiety presence, raises the question of the costs versus benefits of SSS programs. To examine this from the family's perspective, data was collected about their evaluation of the referral process and parent reported financial burden. Families were asked several questions including: if their school provided information to them about scoliosis and the referral process, if that information addressed their concerns, if the family did any independent research on scoliosis evaluations, if the family discussed their appointment with their child, if they found the SSS referral process beneficial, if they found their TSRHC appointment beneficial, their level of comfort at TSRHC, the amount of financial burden incurred through this referral, and number of work/school days missed as a part of this referral. We hypothesized families who were not diagnosed AIS (false-positive referrals) would report less satisfaction than those who were diagnosed (true-positive referrals). However, analysis revealed no significant differences between the false-positive and true-positive referral groups regarding amount and type of information provided by the school on scoliosis evaluations, regarding independent research done on scoliosis, or on their evaluation of the SSS referral or their care at TSRHC.

While the groups showed no significant differences, overall the rates of information distributed to the families appeared low. For both groups, more than half (55.5%) indicated that they received no information from the school about scoliosis or the referral and evaluation process. According to the Texas SSS guidelines, schools must notify parents of

the screening dates and they have the option of enclosing the "Watch Out for Scoliosis" brochure, if they choose (See Appendix C for examples of materials provided to parents) (Sater et al., 2011). From the percentage rates of this study, it appeared more common that schools did not disseminate this information to the families. This could also be attributed to children not bringing the brochure home, or forgetting to give it to parents. However, a third (33.3%) of the families who did receive information indicated that the information provided did not adequately address their concerns going into the evaluation. This lack of information dissemination may largely explain the presence of anxiety in these families that decreased by the end of their TSRHC appointment with the receipt of more information provided by the medical team.

Contrary to our hypothesis that the false-positive group would report less satisfaction with the SSS referral and TSRHC evaluation, both groups reported high levels of satisfaction. 71% of the false-positive group reported they found SSS beneficial, 14% reported they found SSS not beneficial, while 14% reported being unsure. The true-positive group was comprised of 85% who found SSS beneficial, 0% found SSS not beneficial, and 15% reported they were unsure. One hundred percent of both groups report their appointment to TSRHC as beneficial. These findings suggested that despite the experience of anxiety going into the appointment and despite the outcome of the appointment (diagnosis or not), families appreciated the value/benefit of the SSS program and the evaluation process.

Exploratory Aim

Beyond evaluating the emotional cost/benefits of SSS programs, an additional aim of this study was to assess financial and time costs for families. The institutional costs of SSS programs were difficult to calculate given the various screening methods used across the world. As previously indicated, institutional costs of screening per child have been reported as low as .07 USD to as high as 43.7 USD depending on the variables included (Sabirin et al., 2010). Some analyses only reported the costs of the screeners, while others included training costs, diagnostic testing, treatment, and everything in between (Sabirin et al., 2010). This study examined parent reported financial burden from the SSS referral process (time of screening through evaluation appointment), rather than the institutional costs of screenings. Families in this study reported financial burden associated with lost wages, traveling (i.e. gas), appointment and insurance charges, childcare expenses, and meals. The mean amount spent by this sample of patients was $467.56 for their SSS evaluation process. These families also reported less than one day of school and/or work missed for the evaluation process. Again, from the families' perspective, these financial and time costs appeared to have no effect on their satisfaction with the SSS referral or evaluation process. It would appear from the family perspective that the benefits of the screening and evaluation (regardless of diagnostic outcome) process outweighed the emotional, financial, and time costs. It should be noted that TSRHC is a masonry hospital that provides services to patients without charge to the families. Therefore, the costs incurred by patients at TSRHC may be less than the costs incurred by families who seek services at other orthopedic institutions.

Costs incurred by TSRHC; however, are much more costly than those reported by the families. According to the TSRHC cost estimates, an initial scoliosis evaluation (including x-rays) for a patient who is not diagnosed with AIS is $872.00 per child. The costs for initial scoliosis evaluation for a patient who is diagnosed and prescribed an initial orthotic brace is $2,259.00, with each additional visit that costs approximately $1,300 and each additional brace that costs approximately $2,000 (a child may require 2 to 3 braces as the child grows). Finally, the total cost for a patient who is prescribed surgical treat (including initial evaluation, follow-up visits, radiology, implants, and inpatient hospitalization) is approximately $125,000. Given that the hospital incurs the cost of $872.00 per child who is evaluated and is not diagnosed with AIS, the hospital accrued a total cost of $12,208 for this study's sample of false-positive referrals alone. Though it appeared that the families in this study still found the SSS referral process beneficial despite the development of anxiety, lack of information disbursement, and financial/time costs, the high institutional costs associated with the programs are also an important factor in assessing the overall cost/benefit analysis of SSS programs.

METHODOLOGICAL CONSIDERATIONS

Several limitations of this study should be considered when evaluating the generalizability of the study results. Primary analysis involved evaluating the state-anxiety levels present at the onset of hospital appointment between both the patient and the control groups. The sample size of the study was adequate to assess the primary hypotheses, but may have been too small

for adequate examination of additional hypotheses that would have benefited from more advanced statistical models. This may have been especially true in analyses that required groups to be further differentiated by outcome diagnosis (as the patient group was broken down into diagnosed versus non diagnosed). Therefore, the number of participants classified as diagnosed and un-diagnosed were relatively small, which may have caused the level of significance in some of the analyses to reflect a lack of power to detect true differences.

Regarding demographic variables, results indicated that there were no significant differences between the patient group and control groups. However, both groups were comprised of mostly Caucasian, higher SES, and female (both parent and child) participants. This relatively homogenous group of participants may not accurately reflect the general population being referred through SSS programs. However, it should be noted that the prevalence of AIS is more common in females, and therefore this particular demographic variable may be representative of this group. One possible explanation for why families of higher SES are represented in this study sample is that these parents may have the available resources to follow-through on pursuing specialty medical care for their children. Families of lower SES, who do not have the resources to pursue follow-up evaluations, may have different experiences and reports of the SSS referral process, which may not be adequately captured here. Another possible limitation of this study was the inclusion of only one parent per child. Further, most of the parents in this study were mothers, and the research previously reported indicated a preponderance of anxiety symptoms in the female population (Waters et al., 2012).

An additional limitation of this study was the inclusion of several children in both the patient group (3 children total) and control group (1 child total) who were previously diagnosed with Attention-Deficit Hyperactivity Disorder. This mental health diagnosis may have confounded the findings on reports of state-anxiety, though this was unlikely given the very small proportion of participants with the disorder.

An additional limitation to consider was the mean length of time between the family's notification of SSS referral and their evaluation appointment at TSRHC. The mean length of time reported by the families was 8.11 months (247 days) between referral receipt and orthopedic evaluation. This is a significant amount of time that may factor into the families' experience with the referral process. Those who immediately received the evaluation after the referral may have reported different experiences. Unfortunately, the time frame for this study's recruitment schedule did not align with the time of the year that SSS referrals were completed in the community. This likely explains why our sample had such a delay between referral and evaluation.

CLINICAL IMPLICATIONS AND FUTURE DIRECTIONS

Adolescent Idiopathic Scoliosis affects between 2 and 4 percent of the adolescent population (Reamy & Slakey, 2001; Wise et al., 2008; Wong & Liu, 2003) and constituted approximately 602,884 visits to physician offices in one year (Dolan & Weinstein, 2007). School screenings for scoliosis have been implemented for over 60 years to identify AIS and prevent unnecessary progression of spinal curves through early treatment. Currently, all 50 states perform some form of spinal screening in the school system, 21 of which have

legislation that mandated implementation of screening programs (Sater et al., 2011). Despite the high prevalence rates and serious symptoms related to scoliosis, the mass and routine screenings for AIS remain controversial. National organizations including the American Academy of Orthopaedic Surgeons, Scoliosis Research Society, Pediatric Orthopaedic Society of North America, and the American Academy of Pediatrics have claimed to not support any recommendation against scoliosis screenings in schools (Grivas, Vasiliadis, & O'Brien, 2008). However, a number of consistent concerns are frequently voiced in research and among legislatures preventing SSS programs from being more broadly accepted, including high false-positive rate of referrals, excessive costs, unnecessary radiation exposure, and potential emotional/psychological burden to families (Adler et al., 1984; Goldberg et al., 1995; Grivas, Vasiliadis, & O'Brien, 2008; Karachalios et al., 1999; Morais et al., 1985; Sabirin et al., 2010). Institutional costs and false-positive referral rates have been extensively examined over the years. Understanding the emotional toll SSS referrals may have on families is an important aspect of investigation that has only been anecdotally addressed. In a systematic review of the literature, no study to date examined the SSS program and referral process from this psychological and patient/family-oriented perspective. This current study, to our knowledge, is the only study to have collected objective data that examined these areas of concern in the SSS debate.

The results of this study suggested that children and parents referred through the SSS program experience significantly elevated levels of state-anxiety upon arrival to the hospital than those in the control group. This supports the subjective concerns of anxiety experiences in families voiced by researchers who evaluated the effectiveness of SSS programs. Results

also demonstrated that anxiety across all participants decreased by the end of their appointment, which suggested that anticipatory anxiety present upon arrival to the hospital slightly declined as the family became comfortable with the hospital and/or staff members. It is important to recognize this heightened anxiety at the forefront of the evaluation, as previous research indicated that anxiety within the healthcare setting has been associated with disrupted recall of information, poor attention, reduced satisfaction, poor patient-doctor communication, and patient non-compliance (Court et al., 2009a).

Results of this study also demonstrated that despite this heightened anxiety, overall, families found the SSS program and evaluation process helpful and beneficial to their family, even when the child was not diagnosed with AIS (false-positive referral). This suggested that families deemed the costs of the referral process (emotional, financial, and time) worthy of the benefits of the referral and evaluation process. Though researchers, legislators, and medical professionals were accurate in their perception of increased anxiety in families, it may not constitute a significant enough burden to consider it a reason for dismissal of SSS programs altogether, at least not from the patient/family perspective.

This study also provided additional information on the financial burden of both the patient/family and an institution providing initial scoliosis evaluations. Findings revealed relatively low family financial burden and time from school and work, though institutional costs per false-positive referral could be quite impactful considering the near 50% false-positive referral rate reported in this study and most other studies reporting efficacy rates. A full cost-analysis of the Texas SSS programs from the family and institutional perspectives may be an important follow-up study.

Though families may report overall satisfaction with SSS referrals and TSRHC evaluation, more than half of the sample received no information from the school about scoliosis or the referral and evaluation process. Though Texas SSS guidelines provide schools with a brochure that they may opt to disseminate to families, it appeared that this was infrequently completed or the information did not make it home to parents. Implementing targeted methods for information dissemination to the parents may be warranted (e.g., mailing information directly to parents, e-mailing information, phone calls, or having a parent signature on the information before screenings).

Additionally, a third of the families who did receive the brochure indicated that the information provided was inadequate in addressing their concerns about the referral and evaluation process. This lack of information dissemination may largely explain the presence of anxiety in these families that decreased by the end of their TSRHC appointment with the receipt of more information provided by the medical team. Requiring schools to disseminate more specific and robust information about SSS referrals and evaluations may be a simple step that could impact the family experience and improve the overall operations of SSS programs. Further, providing families with specific resources (i.e., websites, articles, books, etc.) where they can access additional information may provide direction for families to answer their questions and ease their concerns.

Beyond the specific aims of this study, the broader goal of the study was to inform integrated medicine from a psychological and patient-oriented perspective. This study addressed a real-world problem that has frequently been debated yet not previously scientifically investigated. We hope that the results of this study are able to provide important

data that informs health care policy for the benefit of the providers and consumers in pediatric healthcare. As this is the first study that examined this issue to date, additional research on a larger scale would be beneficial to ensure replication of study findings and generalizability across communities.

FIGURES AND TABLES

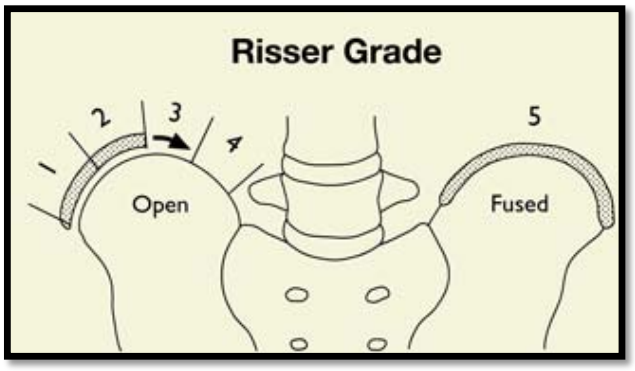


Figure 1. Image of the Risser grade classification. The Risser grade (on a scale from 0 to 5), gives an estimate of the amount of skeletal growth that remains by grading the progress of bony fusion of the iliac apophysis of the pelvis.

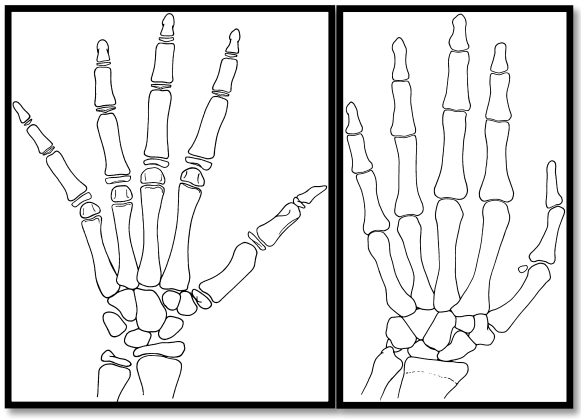


Figure 2. Image of the Tanner-Whitehouse-III RUS (radius, ulna, small bones of the hand) method to determine bone age. The RUS method uses the distal, radial, and ulnar epiphyses (the rounded end of a long bone, at its joint with adjacent bones) and the metacarpal and phalangeal epiphyses of the first, third, and fifth digits for determination of skeletal age. Left image is a skeletally immature hand, while right image is a fully matured skeletal hand.

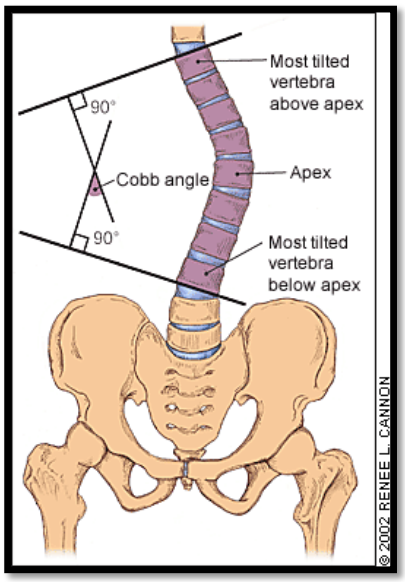


Figure 3. Image of the Cobb Angle method of determining curve magnitude. It is the angle formed when a line is drawn perpendicular to the top of the superior vertebrae of the scoliotic curve and a similar perpendicular line drawn along the bottom of the inferior vertebrae.

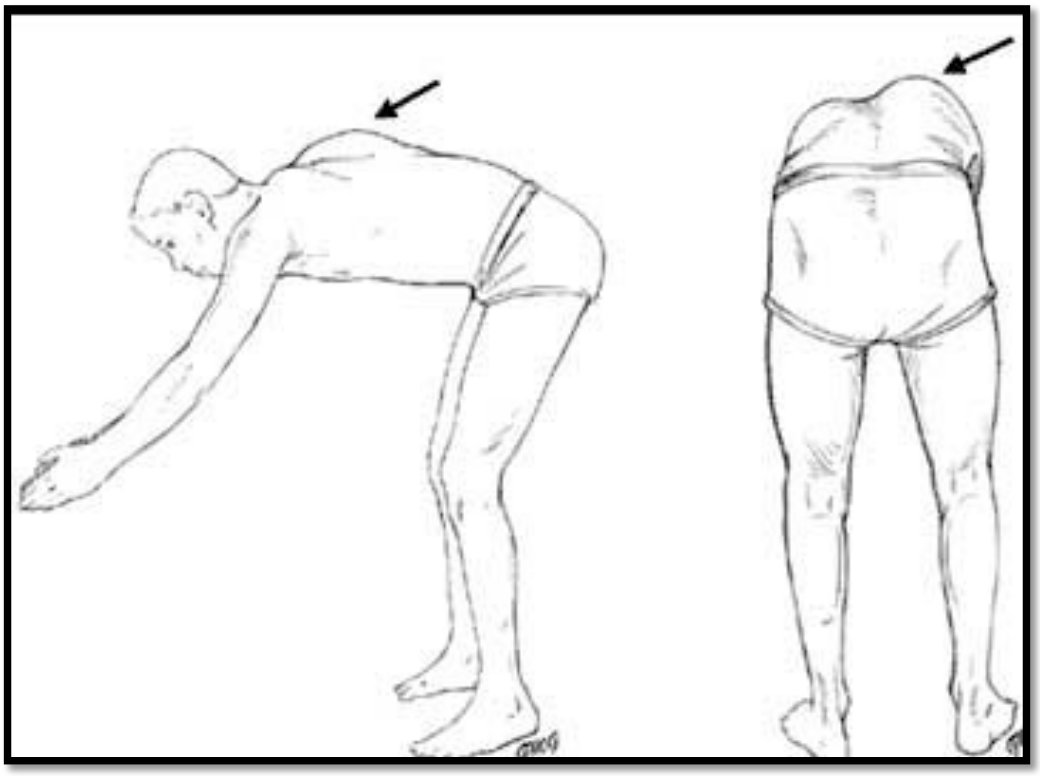
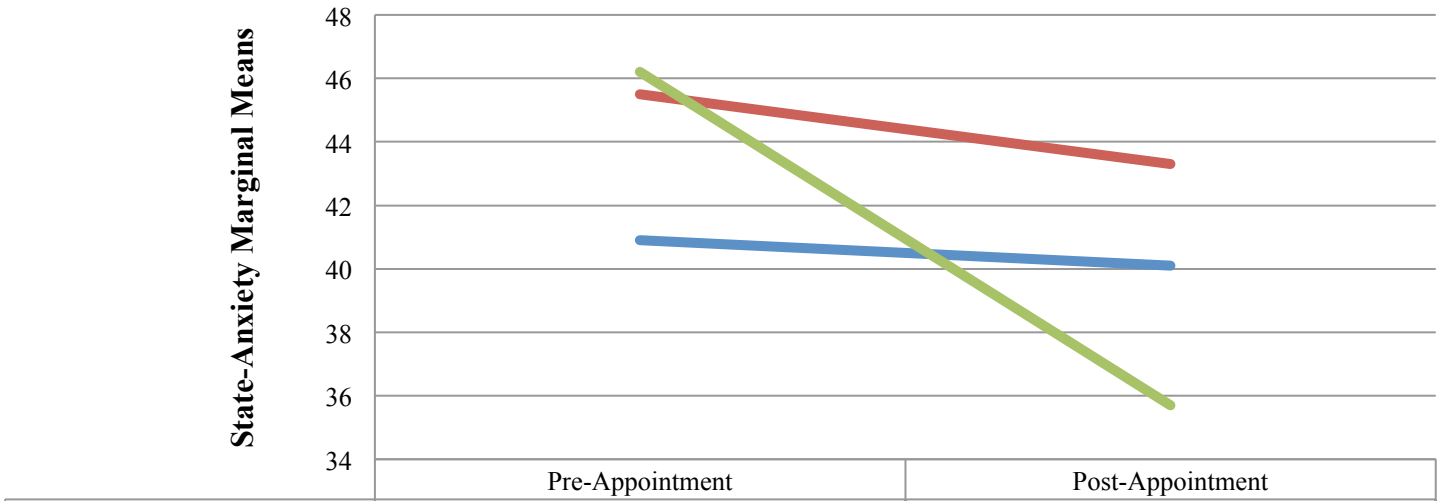


Figure 4. Image of the Adams Forward Bend (AFB) test. With this assessment, the child bends forward at the waist until the spine is parallel with the horizontal plane, while holding palms together and arms extended. The examiner then looks along the horizontal plane of the spine from the back and side to determine if there is asymmetry in the contour of the back, which is known as a "rib hump."



	Pre-Appointment	Post-Appointment
Healthy Control	40.9	40.1
True-Positive (AIS Dx)	45.5	43.3
False-Positive (No AIS Dx)	46.2	35.7

Figure 5. Child STAI-State Anxiety means at pre and post hospital appointment. Covariate appearing in the model are evaluated at the following values: Child Trait-Anxiety Mean T-Score = 42.4.

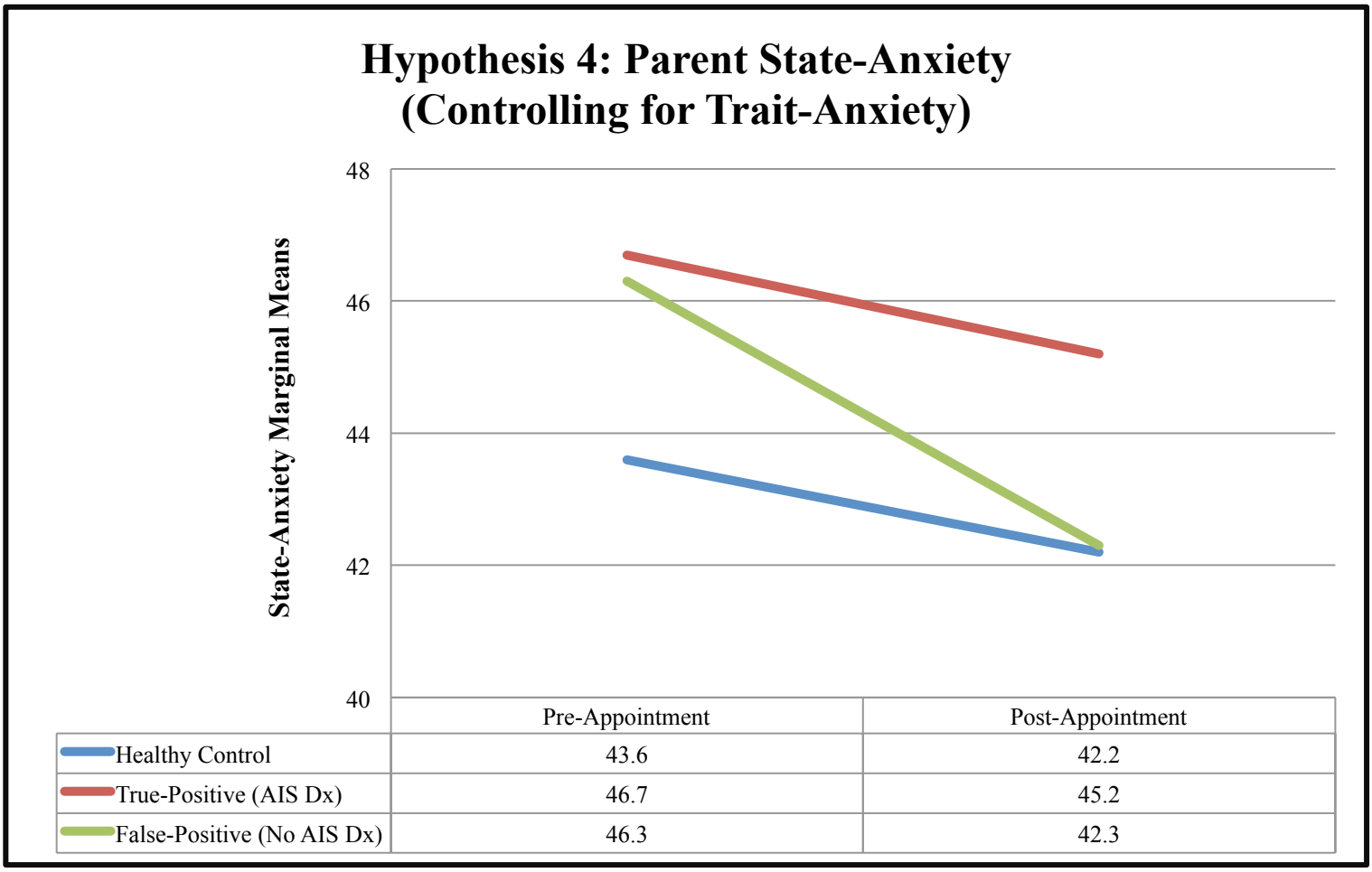


Figure 6. Parent STAI-State Anxiety means at pre and post hospital appointment. Covariate appearing in the model are evaluated at the following values: Parent Trait-Anxiety Mean T-Score = 48.4.

Table 1

Demographic Information for Participants of the Study

	Patient Group N=27	**Control Group N=27**	
	N (%)	N (%)	*χ2 (p)*
Gender			0.77 (0.38)
Male	10 (37.0)	7 (25.9)	
Female	17 (63.0)	20 (74.1)	
Parent-Child Gender Relationship			0.67 (0.41)
Same Sex	13 (48.0)	15 (55.6)	
Opposite Sex	14 (52.0)	12 (44.4)	
Race			3.97 (0.55)
White	13 (48.1)	14 (51.9)	
Black	2 (7.4)	1 (3.7)	
Asian	2 (7.4)	6 (22.2)	
American Indian	1 (3.7)	0 (0.0)	
Hispanic or Latino	6 (22.2)	4 (14.8)	
Other	3 (11.1)	2 (7.4)	
Grade Level			9.81 (0.37)
Third Grade	0 (0)	1 (3.7)	
Fourth Grade	0 (0)	1 (3.7)	
Fifth Grade	2 (7.4)	1 (3.7)	
Sixth Grade	3 (11.1)	1 (3.7)	
Seventh Grade	7 (25.9)	4 (14.8)	
Eighth Grade	3 (11.1)	1 (3.7)	
Ninth Grade	4 (14.8)	5 (18.5)	
Tenth Grade	4 (14.8)	6 (22.2)	
Eleventh Grade	4 (14.8)	3 (11.1)	
Twelfth Grade	0 (0)	4 (14.8)	
Social Status			9.14 (0.06)
5 (Lowest SES)	1 (3.7)	0 (0)	
4	4 (14.8)	2 (7.4)	
3	5 (18.5)	0 (0)	
2	2 (7.4)	6 (22.2)	
1 (Highest SES)	15 (55.6)	19 (70.4)	
	Mean (SE)	**Mean (SE)**	*t (p)*
Participant Age	13.37 (0.35)	14.07 (0.43)	-0.54 (0.50)

**Significant (p=<.05)* ***Significant (p=<.01)*

Table 2

Clinical Information for Participants of the Study

	Patient Group N=27	**Control Group N=27**
	N (%)	N (%)
Mental Health Diagnosis		
Yes	3 (11.1) (ADHD)	1 (3.7) (ADHD)
No	24 (88.9)	26 (96.3)
Previous Surgeries		
Yes	3 (11.1)	0 (0)
No	24 (88.9)	27 (100)
Diagnosed with AIS		
Yes	13 (48.1)	N/A
No	14 (51.9)	N/A

Table 3

Hypothesis 1: Child State-Anxiety at Pre

	Patient Group N=27	**Control Group N=27**	
	M (SE)	M (SE)	*t (p)*
State-Anxiety at Pre-Appointment	45.74 (1.56)*	41.07 (1.59)	2.10 (0.04)*

**Significant (p=<.05)* ***Significant (p=<.01)*

Table 4

Hypothesis 2: Parent State-Anxiety at Pre

	Patient Group N=27	**Control Group N=27**	
	M (SE)	M (SE)	*t (p)*
State-Anxiety at Pre-Appointment	47.48 (1.70)*	42.56 (1.10)	2.43 (0.02)*

**Significant (p=<.05)* ***Significant (p=<.01)*

Table 5

Hypothesis 3: Child State-Anxiety Change Over Time (Controlling for Trait-Anxiety)

	False-Positives (No AIS Dx) N=14	**True-Positives (AIS Dx) N=13**	**Control Group N=27**	
	M (SE)	M (SE)	M (SE)	*F (p)*
State-Anxiety at Pre-Appointment	46.16 (1.87)	45.46 (1.94)	40.99 (1.35)	11.21 (0.00)**
State-Anxiety at Post-Appointment	35.72 (2.16)**	43.34 (2.24)	40.06 (1.55)	

**Significant (p=<.05)* ***Significant (p=<.01)*

Table 6

Hypothesis 4: Parent State-Anxiety Change Over Time (Controlling for Trait-Anxiety)

	False-Positives (No AIS Dx) N=14	**True-Positives (AIS Dx) N=133**	**Control Group N=27**	
	M (SE)	M (SE)	M (SE)	*F (p)*
State-Anxiety at Pre-Appointment	46.27 (1.43)	46.70 (1.50)	43.56 (1.04)	0.85 (0.44)
State-Anxiety at Post-Appointment	42.26 (1.82)*	45.15 (1.90)	42.24 (1.32)	

**Significant (p=<.05)* ***Significant (p=<.01)*

Table 7

Hypothesis 5: Scoliosis Diagnosis Outcomes

	False-Positives (No AIS Dx) N=14	**True-Positives (AIS Dx) N=13**		
	N (%)	N (%)	*t (p)*	*χ2 (p)*
AIS Diagnosis	14 (51.9)	13 (48.1%)		
Gender (M:F)	7(50%):7(50%)	3(23%):10(77%)		
Mean Age	13.07	13.69		
Curve Measurement (Cobb)			7.45 (0.00)**	
0-4 Degrees	8 (57.1)	0 (0.0)		
5-9 Degrees	4 (28.6)	0 (0.0)		
10-19 Degrees	2(14.3)	4 (30.8)		
20-29 Degrees	0 (0)	7 (53.8)		
30-39 Degrees	0 (0)	1 (7.7)		
40-49 Degrees	0 (0)	1 (7.7)		
50+ Degrees	0 (0)	0 (0.0)		
Course of treatment (from medical record)				8.31 (0.02)*
None	14 (100.0)	7 (53.8)		
Bracing	0 (0.0)	3 (23.1)		
Monitor/Observation	0 (0.0)	3 (23.1)		
Follow-up appointment scheduled (from medical record)				1.85 (0.17)
Yes	3 (21.4)	6 (46.2)		
No	11 (78.6)	7 (53.8)		

**Significant (p=<.05)* ***Significant (p=<.01)*

Table 8

Hypothesis 6: SSS Experience & Satisfaction

		Patient Group (As Whole) N=27	False-Positives (No AIS Diagnosis) N=14	True-Positives (AIS Diagnosis) N=13	
#	Question Asked of Patient's Parent	N (%)	N (%)	N (%)	χ^2 (p)
1	**Did school provide information on scoliosis?**				0.90
	Yes	12 (44.4)	5 (35.7)	7 (53.84)	(0.34)
	No	15 (55.6)	9 (64.3)	6 (46.15)	
1a	**If yes, did this info adequately address your concerns?**				3.10 (0.38)
	Not Applicable	15 (55.6)	9 (64.3)	6 (46.2)	
	Yes	8 (29.6)	4 (28.6)	4 (30.8)	
	No	3 (11.1)	1 (7.1)	2 (15.4)	
	Not Sure	1 (3.7)	0 (0.0)	1 (7.7)	
1b	**If yes, did you find this information helpful?**				0.36
	Not Applicable	15 (55.6)	9 (64.3)	6 (46.2)	(0.94)
	Yes	9 (33.3)	4 (28.6)	5 (38.5)	
	No	2 (7.4)	1 (7.2)	1 (7.7)	
	Not Sure	1 (3.7)	0 (0.0)	1 (7.7)	
2	**Did you do any research on scoliosis prior to appt?**				2.10
	Yes	17 (63.0)	7 (50.0)	10 (76.9)	(0.15)
	No	10 (37.0)	7 (50.0)	3 (23.1)	
2a	**If yes, where did you look?**				4.19
	Not Applicable	10 (37.0)	7 (50.0)	3 (23.1)	(0.38)
	Internet Search	9 (33.3)	4 (28.6)	5 (38.5)	
	Talked to Professional	1 (3.7)	1 (7.1)	0 (0.0)	
	Talked to Scoliosis Patient	3 (11.1)	1 (7.1)	2 (15.4)	
	Multiple Sources	4 (14.8)	1 (7.1)	3 (23.1)	
2b	**If yes, did this info make you feel:**				4.64
	Not Applicable	10 (37.0)	7 (50.0)	3 (23.1)	(0.20)
	More Concerned	9 (33.3)	5 (35.7)	4 (30.8)	
	Less Concerned	2 (7.4)	1 (7.1)	1 (7.7)	
	Neither	6 (22.2)	1 (7.1)	5 (38.5)	
3	**Did you discuss your appointment with your child?**				0.48
	Yes, briefly	11 (40.7)	5 (35.7)	6 (46.2)	(0.92)
	Yes, moderate amount	11 (40.7)	6 (42.9)	5 (38.5)	
	Yes, in detail	2 (7.4)	1 (7.1)	1 (7.7)	
	No	3 (11.1)	2 (14.3)	1 (7.7)	
4	**Did you find the SSS Beneficial?**				2.01
	Yes	21 (77.8)	10 (71.4)	11 (84.6)	(0.37)
	No	2 (7.4)	2 (14.3)	0 (0.00)	
	Not Sure	4 (14.8)	2 (14.3)	2 (15.4)	
5	**Did you find the appointment at TSRHC beneficial?**				
	Yes	27 (100)	14 (100.0)	13 (100.0)	
	No	0 (0)	0 (0.0)	0 (0.0)	
	Not Sure	0 (0)	0 (0.0)	0 (0.0)	
6	**Please rate your level of comfort with TSRHC:**				0.02
	Not at all comfortable (1)	0 (0)	0 (0.0)	0 (0.0)	(0.88)
	Not very comfortable (2)	0 (0)	0 (0.0)	0 (0.0)	
	Neutral (3)	0 (0)	0 (0.0)	0 (0.0)	
	Somewhat comfortable (4)	2 (7.4)	1 (7.1)	1 (7.7)	
	Very Comfortable (5)	18 (66.7)	8 (57.1)	10 (76.9)	
	Missing data	7 (25.9)	5 (35.7)	2 (15.4)	

**Significant (p=<.05)* ***Significant (p=<.01)*

APPENDIX A
Measures

*****State-Trait Anxiety Inventory-Y (State-Anxiety)*****

SELF-EVALUATION QUESTIONNAIRE STAI Form Y-1

Please provide the following information:

Name_____Date_____S_____

Age_____ Gender (*Circle*) **M F** T_____

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4

*****State-Trait Anxiety Inventory-Y (Trait-Anxiety)*****

SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-2

Name_____Date_____

DIRECTIONS

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	1	2	3	4
22. I feel nervous and restless	1	2	3	4
23. I feel satisfied with myself	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I feel like a failure	1	2	3	4

*****State-Trait Anxiety Inventory-C (State-Anxiety)*****

HOW-I-FEEL QUESTIONNAIRE

Developed by C.D. Spielberger, C.D. Edwards, J. Montuori, and R. Lushene

STAIC Form C-1

Name: _____ Age: _____ Date:_____

DIRECTIONS: A number of statements which boys and girls use to describe themselves are given below. Read each statement carefully and decide how you feel *right now*. Then put an X in the box in front of the word or phrase which best describes how you feel. There are no right or wrong answers. Don't spend too much time on any one statement. Remember, find the word or phrase which best describes how you feel right now, *at this very moment*.

1. I feel.....	❑ very calm	❑ calm	❑ not calm
2. I feel.....	❑ very upset	❑ upset	❑ not upset
3. I feel.....	❑ very pleasant	❑ pleasant	❑ not pleasant
4. I feel.....	❑ very nervous	❑ nervous	❑ not nervous
5. I feel.....	❑ very jittery	❑ jittery	❑ not jittery

*****State-Trait Anxiety Inventory-C (Trait-Anxiety)*****

HOW-I-FEEL QUESTIONNAIRE

STAIC Form C-2

Name: _____ Age: _____ Date:_____

DIRECTIONS: A number of statements which boys and girls use to describe themselves are given below. Read each statement carefully and decide if it is *hardly-ever*, or *sometimes*, or *often* true for you. Then for each statement, put an X in the box in front of the word that seems to describe you best. There are no right or wrong answers. Don't spend too much time on any one statement. Remember, choose the word which seems to describe how you usually feel.

1. I worry about making mistakes.....	❑ hardly-ever	❑ sometimes	❑ often
2. I feel like crying	❑ hardly-ever	❑ sometimes	❑ often
3. I feel unhappy.....	❑ hardly-ever	❑ sometimes	❑ often
4. I have trouble making up my mind.....	❑ hardly-ever	❑ sometimes	❑ often
5. It is difficult for me to face my problems	❑ hardly-ever	❑ sometimes	❑ often

*****Demographic Questionnaire*****

DEMOGRAPHIC FORM

PATIENT STUDY NO.	PATIENT INITIALS	DATE OF VISIT
☐☐☐	☐☐☐	☐☐/☐☐/☐☐ (M M D D Y Y)

CHILD INFORMATION

1. Date of Birth (Month/Date/ Year)

____ ____ / ____ ____ / ____ ____
M M D D Y Y

2. Age: _____ years

3. Sex: ☐ Male ☐ Female

4. Race (check all that apply)

- ☐ White
- ☐ Black or African American
- ☐ Asian
- ☐ American Indian or Alaskan Native
- ☐ Native Hawaiian or Pacific Islander
- ☐ Hispanic or Latino
- ☐ Other (*specify*)_____

5. Education (*choose only one*)

- ☐ Public School (_____ **grade**)
- ☐ Private/Parochial School (____ **grade**)
- ☐ Home School (_____ **grade**)
- ☐ Other (specify)_____(___ **grade**)

6. Child's Living Arrangement

- ☐ Parental Home (*at least one parent*)
- ☐ Relative (other than parent)
- ☐ Shared residence with parents friends
- ☐ Shelter/Homeless
- ☐ Other (*specify*)_____

DEMOGRAPHIC FORM

PATIENT STUDY NO.	PATIENT INITIALS	DATE OF VISIT
☐☐☐	☐☐☐	☐☐/☐☐/☐☐ (M M D D Y Y)

PARENTAL INFORMATION

7. In usual living arrangement who is fulfilling the role of the child's female caretaker?

- ☐ Biological mother
- ☐ Step-mother
- ☐ Adoptive mother
- ☐ Grandmother
- ☐ Other female relative
- ☐ Other female non-relative
- ☐ Mother/Mother figure not present

8. Mother/Mother Figure's age _____ (*years*)

9. In current household, Mother/Mother figure's employment status

- ☐ Working (*outside the home*)
- ☐ Homemaker
- ☐ Unemployed
- ☐ Disabled
- ☐ Retired
- ☐ Student
- ☐ Other (*specify*)_____
- ☐ Mother/Mother figure not in household

10. In usual living arrangement who is fulfilling the role of the child's male caretaker?

- ☐ Biological father
- ☐ Step-father
- ☐ Adoptive father
- ☐ Grandfather
- ☐ Other male relative
- ☐ Other male non-relative
- ☐ Father/Father figure not present

11. Father/Father Figure's age_____(*years*)

12. In the current household, Father/Father figure's current employment status.

- ☐ Working (outside the home)
- ☐ Homemaker
- ☐ Unemployed
- ☐ Disabled
- ☐ Retired
- ☐ Student
- ☐ Other (specify)_____
- ☐ Father/Father figure not in household

13. Number of people living in the home:_____

14. Family Income (from all sources combined, before taxes) Estimate is for most recent year.

- ☐ Less than $2,000
- ☐ $2,000-4,999
- ☐ $5,000-9,999
- ☐ $10,000-15,999
- ☐ $16,000-19,999
- ☐ $20,000-24,999
- ☐ $25,000-34,999
- ☐ $35,000-49,999
- ☐ $50,000-69,999
- ☐ $70,000-99,999
- ☐ $100,000-and over
- ☐ Don't Know
- ☐ Not Applicable

DEMOGRAPHIC FORM

PATIENT STUDY NO.	PATIENT INITIALS	DATE OF VISIT
☐☐☐	☐☐☐	☐☐/☐☐/☐☐ (M M D D Y Y)

15. Occupation of Head of Household

a. Mother/Mother figure: (Title/Position)_____

b. Mother/Mother figure: (Occupation Type, based on 1-9 Classification)_____

c. Father/Father figure: Title/Position)_____

d. Father/Father figure: (Occupation Type, based on 1-9 Classification)_____

1. Farm laborers/Menial Service Workers, Welfare Recipients
2. Unskilled Workers
3. Machine Operators, Semi-Skilled Workers
4. Smaller Business Owners, Skilled Manual Workers Craftsman, Tenant
5. Clerical and Sales Workers, Small Farm and Business Owners
6. Technicians, Semi-professionals and Small Business Owners
7. Small Business Owners, Farm Owners, Managers, Minor Professionals
8. Administrators, Lesser Professionals, Proprietors of Medium Business
9. Higher Executives, Proprietors of Large Businesses, Major Professionals

16. Education

a. Mother/Mother figure: (Education level based on 1-7 Classification) _____

b. Father/Father figure: (Education level based on 1-7 Classification)_____

1. Less than 7th Grade
2. Junior High School (7-9th Grade)
3. Partial High School (10th-11th Grade)
4. High School Graduate
5. Partial College (at least 1 year) or Specialized Training
6. Standard College (at least 2 years)
7. Graduate or Professional Training (Graduate Degree)

DEMOGRAPHIC FORM

PATIENT STUDY NO.	PATIENT INITIALS	DATE OF VISIT
☐☐☐	☐☐☐	☐☐/☐☐/☐☐ (M M / D D / Y Y)

For Research Use Only

Socioeconomic Status Scale

Head of Household
Occupation Type:_____ x 5 = _____
Education Level: _____ x 5 = _____
Sum = _____

Other Working Spouse (For Families with Two Working Spouses)
Occupation Type: _____ x 5 = _____
Education Level: _____ x 5 = _____
Sum = _____

Add Both Totals and Divide by 2 = _____

17. Social Status (1-5) = _____

Social Status
1= 55-66
2= 40-54
3= 30-39
4= 20-29
5= 08-19

*****Experience Questionnaire*****

QUESTIONNAIRE

PATIENT STUDY NO.	PATIENT INITIALS	DATE OF VISIT
☐☐☐	☐☐☐	☐☐/☐☐/☐☐ M M D D Y Y

1. **What was the length of time between receiving the school's notice for need of evaluation and today's appointment?**

   _____

2. **How were you referred to Scottish Rite Hospital?**

   _____

3. **Did your school provide information on scoliosis?**
   - ☐ Yes
     If yes, what information did you received (brochure, brief handout, packet of information on scoliosis, etc)?

     _____
   - ☐ No

3a. **If yes, did this information adequately address your concerns and questions?**
- ☐ Yes
- ☐ No
- ☐ Unsure

3b. **If yes, did you find this information helpful?**
- ☐ Yes
- ☐ No
- ☐ Unsure

4. **Did you do any research on scoliosis prior to this appointment?**
- ☐ Yes
- ☐ No
- ☐ Unsure

4a. **If Yes, where did you look?**
- ☐ Internet Search
- ☐ Talked to a professional
- ☐ Talked to someone with scoliosis
- ☐ Book(s)
- ☐ Other: _____

4b. **If yes, did this information make you feel:**
- ☐ More concerned/worried about the evaluation
- ☐ Less concerned/worried about the evaluation
- ☐ Neither more nor less concerned/worried

5. **Have you and your child/family discussed today's appointment/evaluation?**
- ☐ Yes, though very little/briefly
- ☐ Yes, a moderate amount
- ☐ Yes, in detail/a large amount
- ☐ No

6. **What monetary costs have you incurred from this evaluation process (check all that apply)?**
- ☐ Lost wages
- ☐ Travel costs
- ☐ Appointment costs/Insurance costs
- ☐ Childcare expenses
- ☐ Other, Specify: _____

6a. **If monetary costs incurred, approximate amount:**

_____

7. **Do you and/or your child have any missed days away from school/work for this evaluation/appointment?**
   - ☐ Yes
     If Yes, indicate # of days:

     School: _____

     Work: _____
   - ☐ No

8. **Did you find your child's school screening for scoliosis beneficial?**
- ☐ Yes
- ☐ No
- ☐ Unsure

CONTINUE ON BACK →

QUESTIONNAIRE

PATIENT STUDY NO.	PATIENT INITIALS	DATE OF VISIT
☐☐☐	☐☐☐	☐☐/☐☐/☐☐ (M M D D Y Y)

9. Did you find your child's appointment at Scottish Rite Hospital beneficial?
- ☐ Yes
- ☐ No
- ☐ Unsure

10. Please rate your level of comfort with the medical team at Scottish Rite Hospital:
- ☐ Not at all comfortable (1)
- ☐ Not very comfortable (2)
- ☐ Neutral (3)
- ☐ Somewhat comfortable (4)
- ☐ Very comfortable (5)

11. Does your child complain of pain related to his/her back/spine?
- ☐ Yes
- ☐ No
- ☐ Unsure

11a. If yes, how does your child manage the pain?
- ☐ Prescription Medication (Type/Amount: _____)
- ☐ Over the Counter Medication (Type/Amount: _____)
- ☐ Ice/Heat
- ☐ Rest
- ☐ None
- ☐ Other, Specify: _____

12. Does your child have an immediate family member(s) with scoliosis?
- ☐ Parent
- ☐ Sibling
- ☐ Grandparent
- ☐ Other, please specify: _____
- ☐ None of these

13. Has your child been hospitalized or had any surgical procedures?
- ☐ Yes
  If Yes, why? _____
- ☐ No

14. Does your child receive regular medical care for any reason (i.e. asthma, allergies, diabetes, etc)?
- ☐ Yes
  If Yes, why? _____
- ☐ No

15. Does your child currently take regular medication(s)?
- ☐ Yes
  If Yes, what? _____
- ☐ No

16. Has your child ever seen a psychiatrist/therapist?
- ☐ Yes
  If Yes, when? _____
- ☐ No

17. Has your child ever been diagnosed with any mental illness (i.e. depression, anxiety, ADHD, etc.)
- ☐ Yes
  If Yes, what? _____
- ☐ No

18. Has anyone in your child's immediate family (parents, siblings) been diagnosed or treated for mental illness?
- ☐ Yes
  If Yes, what? _____
- ☐ No

*****Medical Records Data*****

ADDITIONAL STUDY DATA FROM MEDICAL RECORDS

PATIENT STUDY NO.	PATIENT INITIALS	DATE OF VISIT
☐☐☐	☐☐☐	☐☐/☐☐/☐☐ (M M D D Y Y)

1. Patient's Cobb Angle at Clinic Visit?

_____ _____

2. Do they meet criteria for Idiopathic Scoliosis?

☐ Yes
☐ No

3. Suggested course of treatment?

☐ None necessary
☐ Bracing
☐ Halo Traction
☐ Surgical
☐ Other: _____

4. Was a follow-up appointment scheduled?

☐ Yes
☐ No
If yes, date: _____

5. Does the patient report pain in back/spine?

☐ Yes
☐ No
☐ Unknown

5a. If yes, how does patient manage pain?

☐ Prescription Medication
(Type/Amount: _____)
☐ Over the Counter Medication
(Type/Amount: _____)
☐ Ice/Heat
☐ Rest
☐ None
☐ Other, Specify: _____

6. Does the patient report limitations in activities due to back/spine/scoliosis?

☐ Yes
☐ No
☐ Unknown

6a. If yes, how often?

☐ Very Frequent/Daily
☐ Frequently/Weekly
☐ Sometimes/Monthly
☐ Occasionally/Few times a year
☐ Never
☐ Unknown

APPENDIX B
School Spinal Screening Guidelines

School Spinal Screening Guidelines

Written by
Kathy Sater, RN, MSN,
Nancy White, RN, MSN, CPNP & Richard Haynes, MD
Shriners Hospitals for Children - Houston

In collaboration with:
Texas Department of State Health Services

Revised September 2011

INTRODUCTION

School spinal screening was developed to identify adolescents with small spinal curves and refer them for treatment before these curves become too severe. All states do some form of spinal screening to assure students needing evaluation and/or treatment get early attention. The state of Texas mandates spinal screening for students in the 6th and 9th grade using school nurses and other trained adults to screen all students. Careful training and understanding of spinal screening is essential for the success of this program. Schools may implement a program that includes screening in the 5th and 8th grades as an alternative to 6th and 9th. The intent of the state law is to maintain a three-year gap between students' spinal screenings.

A special thanks is extended to the **Scoliosis Research Society** for their permission to reprint the graphics displayed in this manual.

Table of Contents

Table of Contents

THE NORMAL SPINE

The spinal column is made up of 33 vertebrae or bony segments. These are aligned vertically on top of one another and supported by muscles and ligaments (Figure 1). Discs between each vertebrae serve as pads. The purpose of the spinal column is to provide stability, add mobility to the torso, and protect the delicate nerves of the spinal cord.

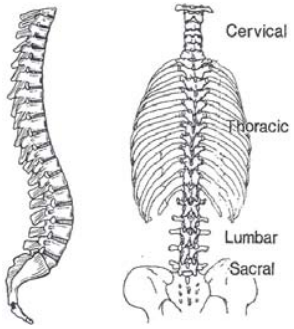
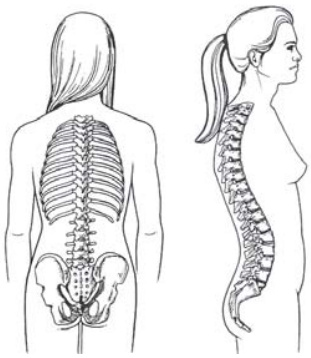


Figure 1

The spine is divided into four main areas: the **cervical** area (neck), the **thoracic** area (chest), the **lumbar** area (small of the back), and the **sacral** area (lower portion of the spine). When viewing the back directly from behind the spine is straight, the shoulders even, hips are level and the distance between the arms and the body are equal (Figure 2).



When viewing the spine from the side, the natural curves of the shoulder and lower back can be seen. The shoulder blades protrude the same amount on each side, creating a symmetric appearance on each side of the spine.

Figure 2

ABNORMAL SPINAL CURVATURE

Spinal screening is designed to detect two major types of spinal deformities: **scoliosis** and **kyphosis**.

Scoliosis

Scoliosis is defined as an abnormal lateral curvature of the spine of 10 degrees or more. This rotation in the spinal column creates a side to side, "S" shaped curve when viewed from behind (Figure 3). Some cases worsen with time and can result in serious problems such as unsightly appearance, occasionally back pain as one ages, and in the worst cases, interference with heart and lung function. Scoliosis is further divided into two categories: **structural** and **functional**.

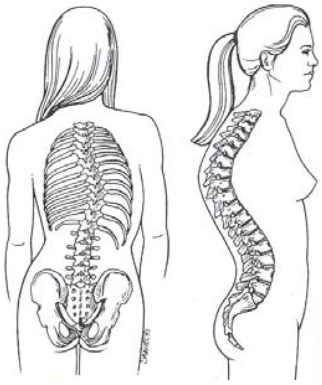


Figure 3

Structural Scoliosis

These curves are the result of changes in the alignment in the vertebrae that are fixed. Structural curves can be distinguished from functional curves by their associated spinal twisting. This twisting results in the hump on one side of the rib cage seen when the student bends forward. Unlike poor posture, these curves cannot be corrected by learning to stand up straight.

Functional Scoliosis

In this type of scoliosis there are no permanent changes in the shape or structure of the spine. Functional scoliosis develops secondary to another abnormality, usually in the hip or lower extremity. The most common cause of functional scoliosis is a difference in the length of a student's legs that makes the child stand unevenly. Uneven leg length can be identifed by having the student stand with one foot on a block of wood. With the hips then at the same level, the spine appears straight. Other causes are muscle spasms, pain, or poor posture.

Incidence of Scoliosis

Eighty-five percent of all cases of structural scoliosis have no known cause and are referred to as **idiopathic scoliosis**. Idiopathic scoliosis occurs in two to three percent of the adolescent population. It commonly affects young people between the ages of 10 to 16 years of age. Gender does make a difference in the time of onset because girls begin their adolescent growth spurt and reach skeletal maturity earlier than boys. This accelerated spinal growth generally occurs from the ages of 10 to 14 for girls and 12 to 16 for boys. The incidence of idiopathic scoliosis occurs equally in early adolescence for both boys and girls for small curves (less than 10 degrees). Curve progression is more common in girls and larger curves are more prevalent. Another factor that can contribute to the incidence of scoliosis in a student is a positive family history of scoliosis, suggesting a genetic predisposition.

In contrast to idiopathic scoliosis, there are several less common types of scoliosis that have a known cause. These curves may be present at birth or related to muscle disorders and are not the focus of school screening because they occur earlier in life.

For idiopathic scoliosis, the earlier in the growth spurt a curve is identified, the greater the risk the curve will worsen. For example, an immature, premenstrual girl has a higher risk of progression than an adolescent female who has begun menses, or an adolescent boy who has developed signs of maturation such as axillary hair.

Idiopathic scoliosis can go unnoticed in a young person because it is rarely painful in the formative years. Signs to watch for are (see Figure 4):

- One shoulder higher than the other
- One shoulder blade higher/more prominent than other
- One hip higher than the other
- Space between arms and body greater on one side
- Leaning to one side
- The head is not centered directly above the pelvis

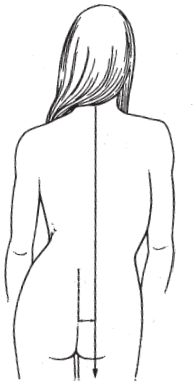


Figure 4

Kyphosis

Kyphosis, or roundback, is described as an excessive curvature of the thoracic spine when viewed from the side (see Figure 5). This deformity can be corrected with exercises and proper posture if it is not fixed. A small percentage of young people have a fixed, structural type of curve called **Scheuremann's kyphosis**, where the vertebrae are actually wedged. The cause for this type of deformity is unknown. Bracing or surgery may be recommended for the immature adolescent with Scheuremann's kyphosis. In relationship to scoliosis, a fixed kyphosis is a much rarer finding in teenagers, but will occasionally be identified during school spinal screening.

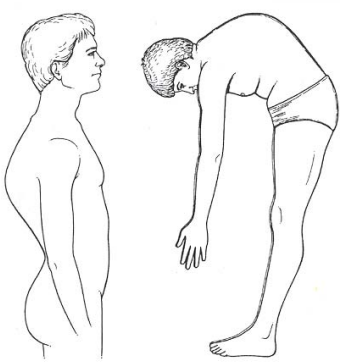


Fig. 5 Kyphosis is an excessive curvature in the thoracic spine.

SPINAL SCREENING PROCESS

Early detection is the key to controlling spinal deformities. The purpose of school screening is to detect scoliosis and kyphosis at an early stage when the curve is mild and may even go unnoticed. Most curves can be treated without surgery if they are detected before they become too severe. The screening process identifies students that have some physical findings that suggest a spinal curve. **The screening process does not diagnose a spinal deformity**. The student showing these findings is referred to a physician who completes an extensive examination and takes x-rays to confirm whether or not the student has an abnormal spinal curve. At that point, the physician can provide recommendations for treatment. The goal of the screening process is to detect a student who needs to be referred at the earliest point, before an abnormal curve gets worse.

Screening Procedure

The examiner may conduct the screening from a seated or standing position. The examiner should place a mark on the floor to show the student where to stand. A distance of 5 to 8 feet between examiner and student is recommended.

Students should remove their shirts so the screener has better visualization of the upper body. Girls should be wearing a bathing suit top, sport bra, or other appropriate clothing item. Students should ideally be wearing shorts as well, to allow better visualization of the waist, hips, and legs. Although the illustrations in this manual depict a student in his underwear, **students should not be screened in their undergarments**. If a student has not dressed appropriately for the screening, provide appropriate clothing or reschedule his or her screening.

The student begins by standing erect with feet slightly apart, knees straight, and arms hanging loosely at his or her sides while facing the examiner. Note the following:

- It is important for the student to face forward throughout the exam positions. Turning the head can cause a change in the findings.
- Long hair should be moved forward to allow full view of the student's back.

1. With the student facing **front** in the standing position (Figure 6), the examiner checks for the following signs of a possible abnormal spinal curvature:

Figure 6

- One shoulder higher than the other
- Larger space from arm to the side of the body (compare both sides)
- Uneven waist creases
- Uneven hip levels

2. The next position is the **Adams forward-bending test**. The student is standing erect with feet slightly apart and knees straight. With the palms of both hands touching, the student bends forward until the back is horizontal (Figure 7). Examine the student in this position to check for:

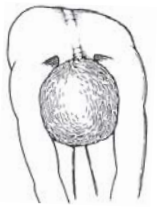


Figure 7

- Uneven contours, humps on one side
- Any curve in the spine

3. View the student from the **side** in the standing position (Figure 8) and check for:

Figure 8

- Exaggerated roundness in upper back
- Exaggerated arch in lower back

4. Next, view the student from the **side** in the forward-bend position (Figure 9) checking for:

   - Uneven contours, humps on one side
   - Flexibility - can the student bend forward and touch upper shins or feet

Figure 9

5. View the student from the **back** in the standing position (Figure 10) and note any of the following:

   - Head is not centered directly above crease in buttocks
   - One shoulder blade wing is higher or stands out more than other
   - Uneven waist creases
   - Uneven hip levels

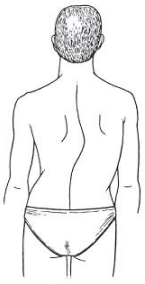


Figure 10

   - One shoulder higher than other
   - Curved spine
   - Larger space from arm to the side of the body (comparing both sides)

   If hips appear uneven, but no other abnormalities are noted, consider possibility of unequal leg length, and visualize alignment of knee creases if possible.

6. Finally, view the student from the **back** in the forward-bending position (Figure 11) to check for:

   - Uneven contours, humps on one side
   - Any curve in the spine

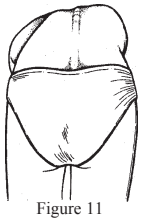


Figure 11

***Students with any positive findings should be re-screened prior to referral**.

Using the Scoliometer (optional)

When some physical findings are present suggesting a spinal deformity, rescreening is necessary to identify which students need to be referred to a physician. The scoliometer is a brand of inclinometer. It is similar to a carpenter's level and designed to measure the degree of spinal rotation. This is particularly helpful when a student has some positive physical findings from the Adams forward-bending test. The purpose is to measure the degree of rotation to identify if the student needs to be referred to a physician for evaluation.

As with any tool, correct use is important to ensure the results are accurate and consistent. To use the scoliometer:

Figure 12

- Place the scoliometer gently across the student's back at the point where a hump or uneveness is most prominent (Figure 12).
- The number "0" should be directly over the top ridge of the spine.
- Do not press down on the device as that can distort the reading.
- Referral is recommended for students with a reading of 7 degrees or more.
- Students with a reading of 5 to 7 degrees should be re-screened in six months to one year to determine if the curve is increasing.

REFERRAL PROCESS

School screening was developed to identify adolescents with small spinal curves, and refer them for treatment before the curves become severe. Although the majority of patients with idiopathic scoliosis do not require more than observation, some will need brace therapy or even surgery. While school screeners can identify physical findings that may suggest spinal curves, they cannot diagnose the reason for the finding or its significance. This must be done by a physician.

The screening process is sensitive enough that some students will be referred that either do not have a spinal problem or do not require treatment beyond observation.

The screener must be careful in communicating with the student and family when a problem is suspected until a final diagnosis is made. If there are concerns about a student's screening results, the screener is encouraged to work with another professional adult to review the findings. Novice screeners are encouraged to work with an experienced screener to gain expertise. A scoliometer may be particularly helpful for re-screening to measure the spinal curve and decide on the need for referral. All students with positive findings are to be re-screened prior to referral.

Proper documentation of the school spinal screening program includes:

- results of initial screening
- results of re-screening
- referrals made
- referral results
- planned follow-up

The **Spinal Screening Worksheet** (Appendix A, page 35) provides space to record all of the above.

A student found to have a possible abnormal spinal curve at the initial spinal screening and re-screening will be referred to a physician. The physician will evaluate whether or not there is truly a spinal deformity. A complete history and physical examination involves re-evaluating the findings noted during the school screening. An x-ray may be taken to allow the physician to see and measure any abnormal curvature of the spine. The most common measurement used is the Cobb method, which identifies the degree of curvature. The skeletal maturity of a young person can also be estimated by evaluating the Risser sign on the x-ray. This is a small ridge of bone that forms over the top of each side of the pelvis. The more complete the Risser sign, the more mature the skeleton and the less risk for any future growth that could increase the curve. Another way the physician may estimate bone/skeletal maturity is through a hand x-ray. This works because bones in the hand mature at different times during the child's growth spurt. The amount of curvature in degrees and the maturity of the skeleton at the time of discovery will determine the treatment selection.

MANAGEMENT OPTIONS

Management options for spinal deformities consist of the three "O"s:

Observation

Routine re-screening or observation by the physician is a form of treatment for mild curves. Once the school program refers a student to the physician as a result of a positive finding, the physician may need to follow the adolescent and monitor for any increase in the curve. From the amount of curve and the growth pattern of the child, the physician will decide if and when to add any further treatment. This observation period consists of re-screening regularly throughout the rapid growth years of adolescence until the spine is mature. It is important to note that more than 90% of students with scoliosis require no treatment other than observation.

Orthosis (brace)

Studies show that bracing can prevent the progression of a spinal curve in a growing adolescent (Rowe 1997, Lonstein 1994). This makes it important for students that have mild curves that are progressing to be identified. For a student with scoliosis, preventing the curve from progressing can prevent the need for spinal surgery (Rowe). While the orthosis can prevent worsening of the spinal curve, it cannot undo what curve already exisits.

Bracing is generally recommended for curves of 25 to 40 degrees and for progression of existing curves in adolescents with growth remaining. Use of an orthosis, often called a spinal brace, can prevent progression of the curve. The orthosis supports and puts pressure on the spine to prevent more curvature from forming during active spinal growth. The main factor in achieving a higher rate of success is how many hours in the day the brace is worn. A wearing schedule of 16 hours a day has a success rate of 60%, whereas a wearing schedule of 23 hours a day has a success rate in the 90% range (Rowe). This is a good reason to encourage students to wear their orthoses as prescibed by their doctor.

Various spinal orthoses are available. The TLSO orthosis (Illustration 1) is named by the areas it is designed to stabilize the thoracic, lumbar, and sacral parts of the spine. It is more cosmetically acceptable than the older Milwaukee brace because it can be covered well by clothing.

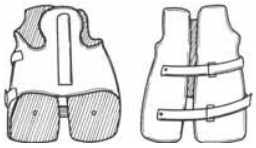


Illustration 1: TLSO Low Profile Orthosis

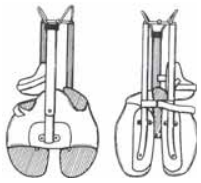


Illustration 2: Conventional Milwaukee Brace

In some cases the curve is high in the spine and will require a Milwaukee brace for correction (Illustration 2). Wearing a brace is not an easy treatment for a teenager. Even covered by clothing, it is hot, hard, and can make the student feel self-conscious. Getting into a daily routine of wearing the brace and participating in activities the student enjoys helps with compliance, which is the key to successful treatment. Even though bracing can be difficult for an adolescent to adjust to, studies have found this to be short-term for the teen with a supportive environment.

Operation: Spinal Fusion and Instrumentation

For those students with a worsening spinal deformity, surgery can reduce a portion of the curve and prevent it from increasing in the future. Usually surgery is reserved for teens and pre-teens that already have a curve of 45 degrees or more. The most common surgical procedure is a posterior spinal fusion with instrumentation and bone graft. This type of surgery involves attaching rods to the spinal column to help straighten it. The bone graft between the affected vertebrae encourages fusion, or joining, of the bone to prevent further progression of the curve. Instrumentation refers to the various rods, hooks, wires and screws which are used to hold the spine in the corrected position while the bone fusion heals. The instrumentation is rarely removed.

Following the surgery, the fused section is no longer flexible. This does not seem to cause a problem unless there is a great number of vertebrae that need to be fused. The average hospital stay is about 5 to 7 days, and the student can usually return to school in 2 to 6 weeks. During the first year after surgery, there will be some limitation on strenuous physical activity. After this healing phase, the surgeon will usually release the student for all activities, including some competitive, low contact sports. Sometimes the physician feels it is necessary to exempt the child from competitive contact sports and gymnastics.

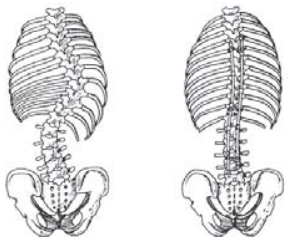


Illustration 3
Spine with double major curve prior to surgery

Spinal fusion with instrumentation. Note significant correction of curve.

Alternative Treatments

Other treatments have been tried for spinal deformities and have not been found to be successful in preventing curves from progressing. Included in this list are electrical muscle stimulation, exercise programs, manipulation, massage, and magnets. These treatments may not be harmful in and of themselves. The concern is that the use of, or belief in, these treatments prevents the family from seeking proven treatment. This delay in medical treatment may cause the adolescent with a progressing curve to get worse and need surgery instead of bracing.

SPINAL SCREENING PROGRAMS

All 50 states perform some form of school spinal screening. In Texas, spinal screening is mandated by state law. Nationwide, 21 states require schools to provide screening. The remaining states provide screening through voluntary programs. There is some variation in the grade levels and frequency of screenings, but all target the time when adolescents are beginning their rapid growth phase.

The shaded states above require spinal screening in schools.

The school system provides a place where all students can be examined and results tracked. Since spinal changes generally do not cause pain, mild curves may not be noticed by parents or cause a visit to the family doctor. Also, as a student matures and becomes more modest, parents may have few opportunities to view his or her back to notice a change. Without school screening, referral and treatment, mild curves may progress into severe scoliosis or kyphosis. These conditions may require major surgery and the results are often less favorable than if the condition had been detected and treated earlier.

Cost Effectiveness

Recent studies have validated the effectiveness of non-surgical treatment in the adolescent with a spinal curve that is progressing. Early detection and initiation of treatment can prevent the need for spinal surgery at a cost of tens of thousands of dollars. Early treatment also prevents the discomfort, need for physical rehabilitation, and interruption in schedule related to major surgery. Surgery can result in a student missing from 2 to 6 weeks of school, and needing homebound instruction during the recovery time.

Frequency of Screening

Ideally, spinal screening should be conducted annually during the growth of adolescence, ages 10-14 (grades 5 through 9), to detect spinal concerns early. **The Texas Legislature has mandated all children in grades 6 and 9 attending public and private schools shall be screened for abnormal spinal curvature before the end of the school year**. The screening requirement for children entering grade 6 or 9 may be met if the child has been screened for spinal deformities during the previous year. **Schools may implement a program that includes screening in grades 5 and 8 as an alternative to grades 6 and 9.** The intent of the state law is to maintain a three year gap between student spinal screenings.

New students or late enrollees that enter a grade which is scheduled to receive spinal screening, and who do not have a record of having received their spinal screening at their previous school, must be included in the spinal screening. If the screening has already taken place for that school year, such students must be screened individually by the end of the school year. Additionally, it is recommended that students entering the district who are past the grades of the screening requirement, but who, according to school records, have never been screened, be included in the annual spinal screening, or be screened individually.

In addition, the program allows for screeners to re-check students they consider to be at risk for developing an abnormal curve. **A sign of possible abnormal curvature (though not enough to warrant referral), along with evidence that a student is in a rapid growth phase, would be criteria for rescreening that student on a more frequent interval, such as in six months, or during the next scheduled school spinal screening**. In males, rapid growth may continue to the age of 16, which the screener may need to take into consideration for follow-up.

Who May Screen

Health aides, licensed vocational nurses, physical education teachers, classroom teachers, and adult volunteers may conduct school spinal screenings after they complete a spinal screening certification workshop conducted by a Department of State Health Services approved trainer.

Licensed professional health practitioners such as registered nurses, nurse practitioners, physician assistants, physicians, chiropractors and physical therapists may conduct the spinal screening without prior certification if their course of study included physical assessment, or they received formal advanced instruction in spinal screening as part of their continuing education. Licensed professional health practitioners are always welcome to attend a spinal screening workshop for additional guidance or to refresh their skills.

With an assistant, an experienced screener should be able to screen 20-30 students per hour. Below is a brief checklist to prepare for spinal screening. Review the **General Organization for Spinal Screening Activities** on the following pages for a detailed outline of the screening process and documentation.

PREPARATION FOR SCREENING CHECKLIST
___ Locate appropriate rooms for screening
___ Obtain student roster
___ Send pre-screening letter to parents
___ Conduct orientation of students
___ Review students to be excluded
___ Remind students of appropriate clothing

EQUIPMENT CHECKLIST
___ Student roster
___ Privacy screens
___ Table
___ Chair
___ Tape to mark floor
___ Pencils
___ Scoliometer (optional)

Establishment of a School Screening Program

Coordinate with school administration.

Verify screeners are state-certified. Arrange for non-certified staff who will be screening to attend a Department of State Health Services-approved screener certification workshop.

Conduct an in-service educational program for school system resource personnel/ administrators, school nurses, physical educators, parent and student representatives.

- Discuss the legal requirements for spinal screening, scope of the problem, rationale and technique of screening.
- Discuss grades to be screened and methodology for screening, including how follow-up of positive cases and referrals will be carried out. Although the law requires screening before the end of grades 6 and 9, exact ages and patterns of screening will vary depending on grade structure of schools and screener availability. Some schools may choose to screen all children in grades 5-9 (ages 10-14).

Determine screening date and site.

Obtain necessary forms (most forms you will need are included in Appendix A).

Publicize screening program via local medical meetings, media, PTA, student groups, and/or parent letter. The **Watch Out for Scoliosis** brochure can be a useful enclosure in these notifications (see Appendix A for samples of the above).

Arrange and perform screening.

Complete follow-up and referral activities.

General Organization for Screening

(See also - School Spinal Screening Flowchart, Appendix C, page 61)

The person responsible for the school/district's spinal screening program will have to coordinate activities with chief administrators, teachers, parents, nurses, and screeners.

Students with Physical Limitations

If for some physical condition a student cannot stand in the manner necessary for the Adam's forward-bend test, do not attempt to screen that student. The screener should contact the student's parents and inform them that their child is at the age where he/she should receive the state-mandated spinal screening. Ask the parents or legal guardian to request a medically appropriate spinal screening from the student's primary physician at his/her next visit, and request the results of this screening for the school's records and the Department of State Health Services Spinal Screening Report (see Appendix A, page 39). It may be helpful to provide the Parent Notification and Referral form to the parents for this purpose (Appendix A, page 37). On the Spinal Screening Report, indicate this student as a referral. Once the parents return the results of a physician's exam, enter the data into the diagnosis/treatment section as appropriate.

Students Under Prior Treatment

If it has been verified that a student is receiving on-going treatment for scoliosis, kyphosis, or other spinal abnormality, then it is not necessary to screen that student. Record this student in the Under Prior Treatment column of the Spinal Screening Report. Do not record the student's diagnosis or treatment on the form. That data is only for students that have received a parent notification and referral from the school. If unable to verify a student is under prior treatment for a spinal abnormality, then include the student in the school spinal screening.

Preparation for Screening

- Students must be screened individually in a space offering privacy. If possible, locate a private area where students can remove their shirt and/or change clothing. A room adjacent to the physical education dressing room is often ideal for screening.

- You may choose to have two or more adults participate in the screening process for security/liability concerns. Assistants can help with preparation and management.

- Conduct orientation sessions for each class of students to be screened. The Department of State Health Services Audiovisual Library lends educational videos for children that explain the importance of spinal screening and allay any fears they may have (see Resources, Appendix C, page 62 for titles and ordering info).

- Determine the amount of time needed to conduct the screenings and develop a schedule. With an assistant, an experienced screener should be able to screen 20 to 30 students in an hour. If necessary, coordinate this schedule with the teachers who will need to release their students from class on those days.

- Send out a pre-screening letter to the parents (see **Sample Pre-screening Letter** in Appendix A, page 27). You may also enclose the Watch Out for Scoliosis brochure (Appendix A, page 29).

- Have a roster of students available using the Spinal Screening Worksheet (Appendix A, page 35) or a similar form.

- Students whose parents have submitted an Affidavit of Religious Exemption are excused from screening. Appropriate personnel should be notified privately regarding these students.

- Parents may choose to have the screening conducted by a physician instead of the school. In this case, parents are asked to provide signed results of an Adam's forward-bending test from a physician's office by the end of the school year the student is scheduled for screening, or by the beginning of the following school year if the exam is obtained during the summer holiday. The Parent Notification and Referral form (Appendix A, page 37) is useful for parents to use for this purpose.

- On the day before the screening, remind students of the screening's purpose. Remind boys and girls to wear or bring shorts, and remind girls to wear a two-piece swimsuit top, a halter top, or sports bra. **Speak positively**, and refer to this activity as "spinal screening" rather than "screening for scoliosis and kyphosis."

- It can be helpful to have some extra sports bras and gym shorts on hand for students that do not dress appropriately that day. They should be provided a space to change into these in private.

Screening

- The screener may use a chair. There should be a table nearby for use in writing down information, and a place for students to place shirts and jackets. The screener should be five to eight feet from the student. Place a strip of tape on the floor to mark the place the student is to stand. Good lighting will facilitate the screening.

- Some students find the screening process upsetting. This can happen if the student feels unprepared or does not have appropriate attire. It is strongly recommended these students be allowed to visit with the counselor, school nurse, or other trusted staff person privately, or allowed to call their parent/guardian. Often these students will calm down and be able to participate in screening. If not, add the student's name to list of those needing to be rescheduled for their screening.

- Check students with their shirts removed. Girls are to be examined with their halter top, swim top, or sport bra on.

- In order to save time, have some students wait in a separate but nearby area. These students should not be in a location where they are able to see their peers receive the screening. An aide or volunteer may assist in maintaining the flow of students.

- Record the name of each student in the class on the Spinal Screening Worksheet or use a classroom roster. Record all positive findings next to the student's name on the worksheet. If a student does not receive the screening, note the reason next to his/her name.

- Arrange to re-screen students with positive or abnormal findings within two weeks. screen those students who missed the initial screening at that time as well.

- Use of the scoliometer (optional) to re-screen will assist in determining which students need referral. Refer those whose spinal curve on the scoliometer is 7 degrees or more. If possible, ask another certified screener to re-screen with you for reassurance that your screening is accurate. If a student has a reading between 5 and 7 degrees, the Department of State Health Services recommends rescreening that student in six months to a year in case the curve is increasing.

FOLLOW-UP ACTIVITIES

Absentees

Students who were not screened due to absence should be scheduled for screening as soon as possible. Ideally, these screenings can be carried out during the re-screening of students found to have positive findings at the initial screening. The second screening should be conducted approximately two weeks after the initial screening.

Exclusions

If a student was excluded from screening for any other reason, have his/her reason documented and included in his/her school health record.

Positive Findings

While screening the absentees, use the session to re-screen all students with positive findings at the initial screening. The original worksheet may be used at the re-screening. If initial positive findings are not confirmed, the parents need not be contacted. If a positive finding is confirmed by the person who re-screens, the parent, guardian, or managing conservator should be contacted as specified in the following section.

Contacting the Parent/Guardian

As a courtesy, **telephone** the parents to explain that a professional evaluation is recommended as a precaution. Give reassurance that many findings are of no consequence, but professional observation may be needed to determine that the signs are not worsening. Inform parents that they will receive written notification of the screening findings in the form of a Parent Notification and Referral form (Appendix A, page 37), which they should take with them to the professional exam. This form is to be completed and returned to the school.

Financial Assistance

Certain families may be eligible for state health insurance under the TexCare Partnership Plan. This plan allows families to receive Medicaid or CHIP dependent upon financial requirements. Applications are available by telephoning 1-(800)-647-6558. Further information is available at **www.texcarepartnership.com**.

Follow-up Letter

The law requires that the parents/guardians of students with abnormal screening results be notified in writing. For this purpose, use the Parent Notification and Referral form (Appendix A, page 37). This form contains spaces to record the results of the screening, and includes instructions to the parents, guardian or managing conservator to obtain a professional examination for their child by an appropriate health practitioner.

Referrals

The school screening coordinator or designee should maintain a record of students whose health care providers report no abnormalities, but about whom there is continuing concern on the part of the screener. These students should be tracked as follows:

1) Schedule students to be seen by the school physician or nurse who can be in communication with the student's own health care provider.

2) If the student's health care provider continues to feel that no further action is indicated, re-screen the student in three to six months.

3) If concern persists, these concerns should be discussed with the family and a second medical opinion should be considered.

The school nurse and physical education instructor should be aware of students who are wearing braces. The school nurse may need to supervise skin care. In most cases, students who wear braces are encouraged to participate in a wide range of physical education activities, but the health care provider's recommendations will need to be followed.

Spinal Screening Report (form M-51)

The Spinal Screening Report (Appendix A, page 39) enables the Department of State Health Services to collect data and create an annual report regarding the diagnostic outcomes of school spinal screenings and referrals. In order to obtain accurate data, it is important that the Spinal Screening Report be as complete and accurate as possible.

Detailed instructions for completing the Spinal Screening Report are located on the back of each form. The Spinal Screening Report should be completed by the school or school district and submitted online to the Department of State Health Services no later than June 30th each school year.

Late Exam Results

On the back of the Spinal Screening Report is a smaller table entitled Late Exam Results. This table is provided for districts to record and submit the results of any student spinal screening referrals that were returned after the submittal of the previous year's report to the Department of State Health Services. If there are no late results available, then this table may be left blank.

Documentation

Record on the student's health record the date and results of the screening as well as the results of any referral.

APPENDIX C
Handouts from Texas SSS Program

SAMPLE PRESS RELEASE

A STATEWIDE SCREENING PROGRAM IS BEING OFFERED

The Texas State Legislature passed a law in 1985 that requires all sixth and ninth grade students to be screened for spinal deformities. Early detection of abnormal spinal curvature can prevent serious health problems. This is a problem that may begin during the early adolescent years (from 10 – 14 years of age), with an estimated 1 in 10 adolescents having some degree of abnormal curvature. Curves that are detected early may only require periodic observation by a specialist. Moderate curves may require the wearing of a brace, which is usually supervised by an orthopedic specialist. In most cases, need for major surgery for this deformity can be eliminated through early detection.

Spinal screening for _____
(School and/or School District, City and/or County)

school children has been scheduled to begin on _____, _____.
(Day of Week) (Date)

Children will be screened for two types of spinal deformities: scoliosis and kyphosis. Scoliosis is a condition in which the spine is twisted, causing misalignment of the upper body or lower back. This condition can worsen and lead to much pain, as well as complications of the heart and lungs. Kyphosis is an exaggerated rounding of the spine. Progression of these two conditions can often be arrested if detected early.

For more information regarding the scheduled spinal screening, contact:

_____.
(Name, Title, Phone)

For more information regarding state-mandated spinal screening in Texas schools, contact the Texas Department of State Health Services at 1-800-252-8023.

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SAMPLE PRE-SCREENING LETTER TO PARENTS

Dear Parent/Guardian:

_____ School will be conducting spinal screening on _____. The purpose of spinal screening is to detect the signs of abnormal curves of the spine at their earliest stages so that the need for treatment can be determined. Scoliosis, a common spinal abnormality found in adolescents, is a sideways twisting of the spine. It is usually detected in children between 10 and 14 years of age. Kyphosis, sometimes called round back, is an exaggerated rounding of the upper back and is often confused with poor posture. Many cases of curvature of the spine are mild and require only ongoing observation by a physician when they are first diagnosed. Others can worsen with time as the child grows and require active treatment such as bracing and surgery. Early treatment can prevent the development of a severe deformity, which can affect a person's appearance and health.

The procedure for screening is simple. Screeners who have been specially trained will look at your child's back while he/she stands and then bends forward. For this examination, boys and girls will be seen separately and individually.

STUDENTS SHOULD WEAR OR BRING SHORTS TO SCHOOL FOR THE EXAM. ALL STUDENTS MUST REMOVE THEIR SHIRT FOR THIS EXAM. FOR THIS REASON, WE REQUEST THAT GIRLS WEAR A HALTER TOP, TUBE TOP, SPORTS BRA, OR A TWO-PIECE SWIMSUIT TOP UNDERNEATH THEIR SHIRT ON EXAM DAY.

Parents will be notified of the results of the screening only if professional follow-up is necessary. This screening procedure does not replace your child's need for regular health care and check-ups.

According to state law, all students in grades 6 and 9 (or grades 5 and 8) must receive the spinal screening. If, for religious reasons, you do not wish to have your child screened, you are to submit an affidavit of religious exemption to this office no later than _____.

Thank you for your cooperation,

Sincerely,

_____
(School Administrator)

WATCH OUT FOR SCOLIOSIS

Scoliosis, an abnormal curve of the spine, can be corrected if detected early...

What is scoliosis?
Scoliosis is a "side to side" curve of the back. It is a deformity of the spinal column or backbone.

What causes scoliosis?
Most scoliosis is of unknown cause ("idiopathic"). Recent studies suggest that heredity does play a part in these cases. Therefore, if a person is found to have scoliosis, other family members should also be checked.

Who is affected by scoliosis?
Anyone can be affected by scoliosis. Onset usually occurs between the ages of 10 and 13, when the child begins the rapid growth spurt. Scoliosis can affect members of both sexes, but occurs more frequently in females, who account for approximately 85% of the cases.

Why is screening for scoliosis important?
It is most important to detect the condition as early as possible so that treatment can be provided. Without treatment, undetected scoliosis can get worse rapidly during the growth years and result in physical deformity, limitation of physical activity and other more serious complications.

What are the signs of scoliosis?
Frequent signs are a bump over the shoulder blade; one shoulder or hip higher than the other; unequal distance between the arms and body, and clothes that "don't hang right." These signs are not always noticed and can be easily mistaken for poor posture.

What is the treatment for scoliosis?
In many instances of mild curvature, periodic supervision by a doctor is all that is necessary. When medical treatment becomes necessary, an orthopedic surgeon (bone specialist) may recommend a brace or surgery depending on the condition.

Regular follow-up while the child is wearing the brace is important. The doctor may prescribe a daily exercise and fitness program to maintain the muscles in good shape and promote a sense of well being, but exercise alone will not correct the problem.

When other methods have failed or the scoliosis is severe, surgery may be necessary. After the operation, the child will need to wear a cast or brace for a number of months and continue to be supervised by an orthopedic surgeon. The remaining disability may be minimal and the patient may lead a normal life after recovery.

Are schools required to provide screening?
House Bill 832 passed by the Texas Legislature in 1985 requires screening for abnormal spinal curves in grades 6 and 9 (schools may adopt programs to screen grades 5 and 8 instead of 6 and 9). If a child shows any signs of a possible deformity, the school is required to notify the parents.

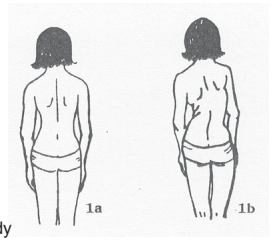
What can parents do?
If notified that their child may have an abnormal spinal curve, parents should take their child to the doctor for a diagnosis. Parents can also learn to check their child for a curve of the spine. If they suspect that their child may have a problem, they may check with the school nurse, the health department, or their private doctor.

Revised February, 2003

Here is a simple way to check your child for scoliosis*

NORMAL

- head centered over mid-buttocks
- shoulders level
- shoulder blades level with no bumps or buldges
- hips level and equal on both sides
- equal distance between arms and body
- straight backbone

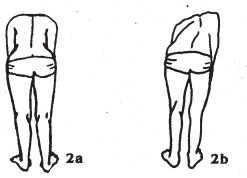


POSSIBLE SCOLIOSIS

- head tilted to one side of mid-buttocks
- one shoulder higher
- one shoulder blade higher with a possible bump or bulge
- one hip sticks out more than the other
- unequal distance between arms and body
- curved backbone

NORMAL

- both sides of upper and lower back are equal
- hips level and equal on both sides

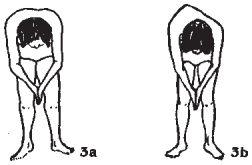


POSSIBLE SCOLIOSIS

- one side of rib cage and/or the lower back bulges out

NORMAL

- even and equal on both sides of the upper and lower back



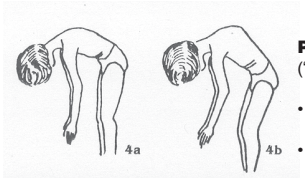
POSSIBLE SCOLIOSIS

- bump or bulge on the upper or lower back, or both

Also Screen for Kyphosis...

NORMAL

- smooth round even arc of the back



POSSIBLE KYPHOSIS
("round back")

- lack of smooth arc
- exaggerated roundness of back

***Courtesy of the National Scoliosis Foundation, Inc.**
www.scoliosis.org

Revised 2/2003

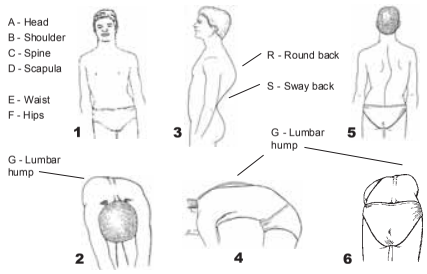
School Spinal Screening Worksheet

School/District:

Screener(s):

Date of Screening:

Grade:



Student Name	M/F	1	2	3	4	5	6	Abnormality Detected	Currently Under Treatment	Rescreened	Rescreen Confirmed Findings	Scoliometer Readings (Optional)	Family Contacted	Referred for Examination	Diagnosis & Treatment Report Received	Additional Follow-Up Required
								Y/N	Y/N	Y(Date)/N	Y/N	/	Y(Date)/N	Y/N	Y(Date)/N	Y/N

FILLING OUT THE SCHOOL SPINAL SCREENING WORKSHEET:
This form is to assist with re-screening and follow-up by providing a place to indicate and reference your initial findings. This form allows you to note the student's position in which a possible abnormality was found, and section(s) of the body indicating that abnormality. Each of the screening positions has a corresponding numbered column. Sections of the body and some of the conditions you may find have corresponding letters. In the appropriate column, place letters to indicate the sections of the body showing a possible abnormality. For example, if one shoulder appears higher than the other when viewing a student in position 1, place a "B" in column 1 under that student's name.

SPINAL SCREENING PROGRAM
PARENT NOTIFICATION AND REFERRAL

STUDENT: _____ BIRTHDATE: _____

ADDRESS: _____

SCHOOL: _____ SCHOOL TELEPHONE: _____

Dear Parent/Guardian:
Students in our schools were recently screened for a curve of the spine that can appear during the years of rapid growth between ages 10 and 16 years. Your child has signs of a possible curve listed below.

Two kinds of curves are scoliosis (sideways curve) and kyphosis (round back). It is your responsibility to take this form to a doctor of your choice who can do a complete check of the spine. After the doctor has examined your child and completed this form, please return it to school. If you cannot afford a doctor or have questions, contact the school for information.

Thank you for your cooperation: _____ _____
Signature of School Administrator or Nurse **Date**

SCHOOL SCREENING FINDINGS:

L	R		L	R	
☐	☐	High shoulder	☐	☐	Rib hump
☐	☐	Shoulder blade stands out more than the other	☐	☐	Obvious curve of spine in lower back
☐	☐	Obvious curve of the spine in area of rib cage	☐	☐	Hip higher than the other side

☐ Round back

Other: _____
School Screener's Name & Title: _____ Date: _____

PROFESSIONAL EXAMINATION REPORT:
Diagnosis: _____
Recommendations:
☐ No Treatment ☐ Treatment: ☐ Observation
☐ Brace
☐ Surgery
☐ Other (please describe): _____
☐ Referral (please describe): _____
Activity Limitation (if any, please describe): _____
Additional Comments: _____
Return Appointment: ☐ No ☐ Yes - Return Date: _____

_____ _____
Doctor's signature or hand stamp **Date**
Doctor's Mailing Address/Phone: _____

For school use:
This form completed and received by school (name/date): _____
This form not returned to school (reason): _____

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