Current knowledge of Idiopathic Scoliosis among practicing physiotherapists in South Africa

By

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Declaration

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Name: Abraham Coetzee (Braam) du Toit **Date:** March 2020

Abstract

Background

The knowledge of Idiopathic Scoliosis has been assessed in Poland, the United States of America (USA), and the United Kingdom (UK) and all the studies concluded that the knowledge of idiopathic scoliosis (IS) among physiotherapy students is limited with respect to the International Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT) guidelines. Early recognition and the correct initial management is essential in this progressive disorder, and thus physiotherapists should be aware of the basic criteria involved in the screening, diagnosis, and treatment of IS patients.

Aim and Objective

The aim of this project was to ascertain the current level of basic knowledge on Idiopathic Scoliosis (IS) among registered practicing physiotherapists that express an interest in the orthopaedic, muscular, manual and manipulative therapy in South Africa. Furthermore, an objective was to compare the knowledge between the physiotherapists that are registered with the Orthopaedic Manipulative Physiotherapy Group (OMPG) and the physiotherapists that are not registered with this group but who are also interested in orthopaedic, muscular, manual or manipulative therapy. The last objective was to identify any knowledge gaps that exist and the potential for future research studies on IS.

Methodology

This was a descriptive study and an online survey was used to collect the data. A previously designed and tested 10-question survey consisted of the majority of the questionnaire. The questions were based on the 2011 SOSORT Guidelines and assessed the following aspects of IS: definition, cause, development, prevalence, diagnosis, treatment, and bracing. The questionnaire also included opinionated questions on the types of physical activity that would

be beneficial/harmful to patient's scoliosis and familiarity with conservative treatment methods for IS. An additional five questions consisted of evidenced based conservative treatment and to ascertain confidence with the assessment, management and education of IS patients. The study was advertised in South African OMPG physiotherapy newsletters with the aim to attract physiotherapists that manage and are interested in the orthopaedic care of patients. The newsletters contained an online link to the information leaflet, consent form, and questionnaire (Appendices A, B, and C). These methods of advertising attracted a diverse group of actively practicing physiotherapy populations of different ages, backgrounds, experiences, with the aim to reduce selection bias and sampling error.

Results

Two hundred and twenty-three (223) Physiotherapists spread across the 9 different provinces/regions of South Africa met the inclusion criteria and formed part of the study. One hundred and sixteen (116) of these physiotherapists were members of the OMPG, and the other 107 physiotherapists were not members of the OMPG but expressed an interest in the orthopaedic, muscular, manual or manipulative fields. The analysis showed that 73.5% was able to correctly identify the aetiology of IS and 86% was able to identify when IS is likely to develop. Forty-eight percent (48%) of the physiotherapists correctly identified IS as a three-dimensional deformity, and 41% of the participants incorrectly thought that IS is a lateral curvature of the spine. The participants had a poor understanding of the prevalence, diagnosis, and treatment involved in IS affected clients with only 16%, 17%, and 26% respectively providing the correct responses. Forty-two-point six percent (42.6%) of the physiotherapy group correctly identified when bracing should be recommended for patients with IS. The study further indicated a lack of knowledge regarding the methods of conservative treatment and scoliosis schools available worldwide, with more than 76% of the group not being aware of any of the schools or recognised any treatment methods used for

scoliosis rehabilitation. In 85% of the questions, the OMPG group performed better than the non-OMPG group. In 42% of the questions in the survey, the OMPG group achieved a higher than 50% 'correct' response rate compared to the non-OMPG group who only managed to achieve a higher than 50% in 28% of the questions.

Conclusion

Our findings showed that about one third (33.6%) of the physiotherapists participating in the study could answer more than 50% of these questions correctly and 16.5% could answer 70% of the questions correctly in relation to the widely accepted guidelines on IS management. The findings indicate a lack of knowledge regarding IS patient prevalence, screening, recognition, diagnosis and treatment. The responses and results in the OMPG group were better than the non-OMPG group but still very low especially due to the fact that only 28% of the OMPG group correctly identified the conservative treatment involved with IS. Future research studies should be aimed at identifying the prevalence of IS at a national level in SA. Investigating the content curriculum at under-graduate level in SA, referral strategies for IS patients in SA, and comparing the management of IS in the private and public sectors of SA.

Keywords

Scoliosis; Idiopathic Scoliosis; IS; physiotherapy AND IS; physical therapy AND IS; clinical signs AND IS; risk factors AND IS; assessment of IS; knowledge of IS; Physiotherapists knowledge of IS; survey AND knowledge of IS; bracing; treatment; causes; screening; diagnosis.

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Abbreviations and Acronyms

IS - Idiopathic Scoliosis

SOSORT - Society of Scoliosis Orthopaedic Rehabilitation Treatment

SA - South Africa

HPCSA - Health Professions Council of South Africa

PSSE - Physiotherapeutic Scoliosis-Specific Exercise

SRS - Scoliosis Research Society

OMPG – Orthopaedic Manipulative Physiotherapy Group

AIS – Adolescent Idiopathic Scoliosis

Chapter 1

LITERATURE REVIEW

1.1 Introduction

Spinal deformities have been reported for thousands of years, and references to them have been found as far back as Hippocrates (460-370 BC). Hippocrates spoke of “spina luxate,” gathering all the vertebral deviations. Hippocrates introduced the terms kyphosis and scoliosis and wrote in-depth about the diagnosis and treatment of kyphosis and less about scoliosis. In the Hippocratic works, the term "scoliosis" had a general meaning and applied to almost every kind of spinal curvature, including those spinal deformities resulting from injuries of the vertebrae with or without dislocation of the vertebral bodies. Hippocrates already then described the anatomy and the diseases of the spine and suggested treatments for patients with spinal deformities [1]. He was the first to introduce three points corrections for the realignment of curvatures of the spine and the management of spinal diseases.

Galen, who lived nearly five centuries later impressively described scoliosis, lordosis, and kyphosis, provided aetiological implications and used the same principles as Hippocrates used in the management of scoliosis. Galen’s studies influenced the medical practice on spinal deformities for more than 1500 years and defined the first “scoliosis” (sKolios, which means crooked or curved), by meaning an abnormal lateral spinal curvature [1]. The definition of Idiopathic Scoliosis (IS) has evolved through research-based evidence and is currently defined as a three-dimensional torsional deformity of the spine [2]. With time,
there have been new research studies conducted that have changed the perceptions, ideas, and knowledge regarding IS. People have always wanted and sought more information from a reliable organisation [3].

The parents of children with scoliosis became increasingly more frustrated with their lack of knowledge and were feeling helpless with the 'wait and see' approach that far too many doctors adopt when dealing with curves between 10° and 25° [3]. Physiotherapists that identified scoliosis in their patients have searched for new treatment methods and a point of reference when requiring more information on the Scoliosis topic [4]. Orthotists were looking for more effective options in managing their scoliosis clients as they have recognised that traditional braces lack the ability to make 3D corrections, producing flat back, or other cosmetic changes [4]. Doctors also sought out alternative rehabilitation methods to help scoliosis patients who are not good candidates for surgery [4]. As a result, the Scoliosis Research Society (SRS), was founded in 1966, and the International Society on Scoliosis Orthopedic and Rehabilitation Treatment (SOSORT), was founded in 2004 to provide research-based evidence and reliable information regarding Scoliosis. Inside the SRS, the Non-Operative Management Committee (SRS-NOC) has the same clinical interest as SOSORT, which is the orthopaedic and rehabilitation (or non-Operative, or conservative) management of IS patients. SOSORT promotes and encourages conservative, evidence-based medicine regarding scoliosis and provides education, guidelines, and consensus about treatment options to people with scoliosis [5].

1.2 Anatomy and Development of the Spine

Curves are usually a natural part of the spine's structure. It resembles a soft 'S' shape when looked from the side (laterally). These normal curves are termed as Lordosis (cervical and lumbar spine) and Kyphosis (thoracic and sacral spine). The vertebral column is a curved linkage of individual bones or vertebrae (Figure 1.1). A continuous series of vertebral foramina runs through the articulated vertebrae posterior to their bodies and collectively constitutes the vertebral canal, which transmits and protects the spinal cord and nerve roots, their coverings, and vasculature (Figure 1.1). Vertebral column morphology is influenced

externally by mechanical and environmental factors and internally by genetic, metabolic, and hormonal factors. These all affect its ability to react to the dynamic forces of everyday life, such as compression, traction, and shear. These dynamic forces can vary in magnitude and are much influenced by occupation, locomotion, and posture. The adult vertebral column usually consists of 33 vertebral segments. Although the usual number of vertebrae is seven cervical (neck), twelve thoracics (chest), five lumbar (low back), five sacral (pelvis) and four coccygeal (tailbone), this total is subject to frequent variability, and there have been reports of variation between 32 and 35 bones. The cervical segments are abbreviated as C1-C7, the thoracic segments as T1-T12, the five fused lumbar segments as L1-L5, and the four fused coccygeal segments have no abbreviation [6-13]. Each presacral segment (except the first two cervicals) is separated from its neighbour by a fibrocartilaginous disc. The fibrocartilaginous intervertebral discs lend flexibility to the vertebral column and absorb vertical shock [2,14]. The vertebrae in the upper three regions of the column are known as true or movable vertebrae.

The functions of the column are to support the trunk, to protect and enclose the spinal cord and nerves, support the head and upper extremities while performing freedom of movement, articulate with the rib cage, and provide for the attachment of various muscles and visceral organs. It is also an important site of haemopoiesis throughout life [10,15,16]. When viewed laterally, the cervical, thoracic, lumbar curves are named by the type of vertebrae they include (Figure 1.1). In a normal spine, there are two types of spinal curvatures that play an essential functional role in increasing the strength and maintaining the balance, flexibility, stress absorption and distribution during rest and movement: (1) kyphosis - a posterior (back) convex angulation of the spine and (2) lordosis – an anterior (front) angulation of the spine in the sagittal plane. Particular degrees of cervical lordosis, thoracic kyphosis, lumbar lordosis,

and sacral kyphosis are present in a normal spine (Figure 1.1); deviations from normal parameters indicate abnormal kyphosis or lordosis or, most frequently, scoliosis [17].

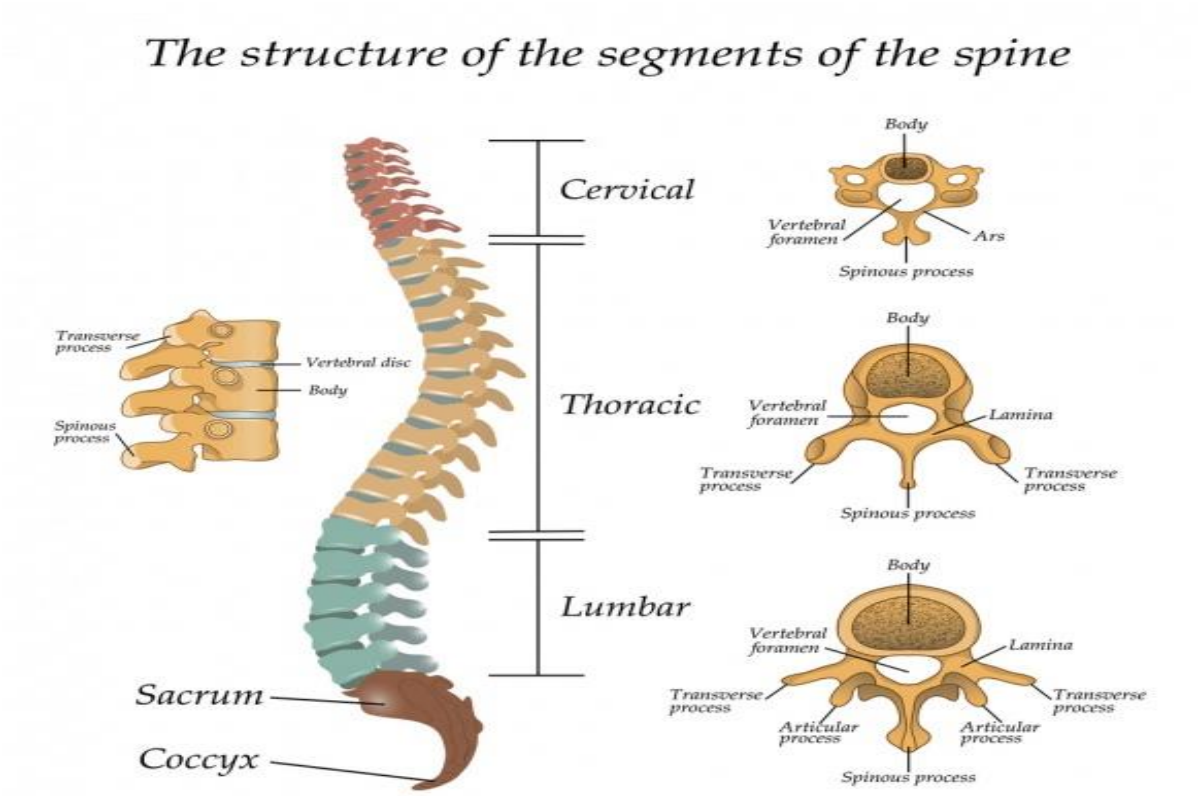


Figure 1.1 The Structure and segments of the spine (Spineuniverse.com).

1.3 Definition of Scoliosis

Scoliosis is typically defined as a three-dimensional torsional deformity of the spine and trunk measuring ≥ 10 degrees (measured using the Cobb angle method, see Section 1.5 below) that affects humans from infancy to after puberty [2]. Further major physical changes that are associated with this 'musculoskeletal condition' are shoulder tilt (one shoulder higher than other) and asymmetrical waistline (tilt in pelvis) when viewed from the front and an elevation of one side of the back or 'rib hump' is observed (Figure 1.2) [2].

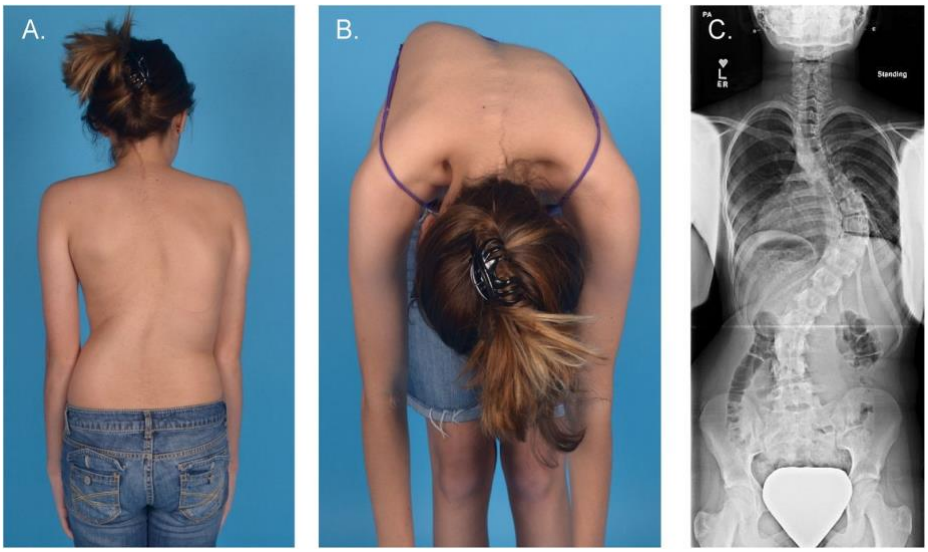


Figure 1.2 A patient with Idiopathic Scoliosis and the X-ray image of her spine (Paria et al., 2015).

1.4 Aetiology of Idiopathic Scoliosis

Despite a prodigious amount of medical research, the specific cause of idiopathic scoliosis remains elusive [18,19]. A myriad of factors has been implicated in the aetiology of this condition [20,21]. The main hypotheses include deficits in structural elements of the spine, spinal musculature, collagenous structures, endocrine function, changes associated with the 'growth spurt' during adolescence and hormones associated with the onset of puberty, central nervous system, vestibular function, and genetic transmission [18,20].

Idiopathic scoliosis is reported to be familial in nature, with a positive relationship between the size of spinal curvature and the proportion of family members affected with scoliosis [22]. Furthermore, approximately 30% of people with idiopathic scoliosis have a positive family history of scoliosis, and when both parents are affected, the risk of their children developing the condition increases 50-fold compared to the general population [23]. The similarity of curve patterns in twins with idiopathic scoliosis [24] and a higher concordance rate in monozygotic as opposed to dizygotic twins also indicate that idiopathic scoliosis is genetically transmitted [24-26]. Despite these results, the mode of inheritance is contentious;

nevertheless, it is generally accepted that idiopathic scoliosis is a familial condition with a multifactorial aetiology [27]. However, all hypothetical causes of idiopathic scoliosis are 'epiphenomena' rather than established causes [28].

1.5 Classification of Scoliosis

In 2001 Burgoyne and Fairbank [30] stated that there are two clinical subtypes of scoliosis: (1) structural (curves that are fixed [with one or more compensatory non-structural curves] and progressive that cannot be abolished as one or more segments of the spine possess a fixed lateral curve) and (2) non-structural or functional (curves are non-progressive and fully correctable; i.e., caused by poor posture, disc herniation, and leg length inequality). It is usually partially reduced or completely subsides after the underlying cause is eliminated (e.g., in a recumbent position) [30]. Cassar-Pullicino & Eisenstein [29] state that non-structural curves may, in some instances, transform into structural scoliosis, although structural scoliosis will be the focus of this study. Structural scoliosis is believed to be a defect in bone, which results in contractures of soft tissues on the concave side of the curve and reciprocal stretching on the convex side [29,31]. Dangerfield [32] stated that any method of classification of scoliosis deformity devised should recognise different aetiological and pathological causes of the conditions and their likely impact on the natural history of the spinal curvature. Structural scoliosis can be classified in terms of pathological, age at onset, and anatomy. Pathologically, scoliosis can be dichotomised into non-idiopathic (i.e. cause is known) and idiopathic (i.e. cause is unknown). The former includes congenital (embryological developmental problem that is present at birth); neuromuscular or paralytic (scoliosis is secondary to conditions such as cerebral palsy, muscular dystrophy, neurofibromatosis, mesenchymal disorders, Marfan's syndrome, rheumatoid arthritis, and osteogenesis imperfecta, and syringomyelia including infections such as poliomyelitis); and trauma (fractures, spinal tumours, burns and rib resection) [32]. The term idiopathic scoliosis

was introduced by Kleinberg [17], and it is applied to all patients in which it is not possible to find a specific disease causing the deformity; it occurs in otherwise healthy children and can progress in relation to multiple factors during any period of rapid growth [17]. Idiopathic scoliosis is the most prevalent type of scoliosis and accounts for approximately 70-90% of all cases in all age categories [33]; however, this is a diagnosis of exclusion and can only be applied with confidence when other causes of spinal deformity have been eliminated [32].

Many different classifications of idiopathic scoliosis have been proposed over the years, but not all of them are relevant for conservative care. Recent developments in 3D reconstructions using standard or digital radiography deepened the understanding and analysis of the scoliosis deformity in all space planes. According to SOSORT consensus, IS can be classified according to chronological, angular, and/or topographic (Table 1.1).

Table 1.1: Classifications of idiopathic scoliosis

Chronological		**Angular**		**Topographic**		
Age at onset (years)		Cobb degrees		Apex:	FROM	TO
Infantile	0 - 2	Low	Up to 20	Cervical	-	Disc C6 – C7
Juvenile	3 - 9	Moderate	21 – 35	Cervico-thoracic	C7	T1
Adolescent	10 - 17	Moderate to severe	36 – 40	Thoracic	Disc T1 - T2	Disc T11 T12
Adult	18+	Severe	41 – 50	Thoraco-lumbar	T12	L1
		Severe to very severe	51 – 55	Lumbar		Disc L1 – L2
		Very severe	56 or more			

Chronological:

James [34,35] was the first to propose that scoliosis should be classified based on the age of the child at the time the deformity was first diagnosed. This classification is essential because the longer the time between diagnosis and completion of growth by the developing child, the higher the risk for developing more severe deformity and complications. James proposed the

following three categories: (1) infantile; (2) juvenile; (3) adolescent. In the past, progression was believed to cease at maturity [36]; however, curves that progress (or become symptomatic) in adulthood are referred to as progressive adult idiopathic scoliosis or adolescent idiopathic scoliosis of the adult (occurring after skeletal maturity between the ages of 20 and 50). This must be differentiated from degenerative scoliosis (a type of non-idiopathic scoliosis caused by degenerative disk disease with no previous history of spinal deformity) that typically occurs in adults aged over 50 [37].

Angular:

The Angular method of classification is where the angle of scoliosis is measured according to the Cobb method. Assessing the curve pattern using the Cobb angle is the most frequently used method. The measurement is taken on a standing frontal radiograph. This is calculated by selecting the most tilted vertebrae above and below the apex of the curve obtained from a standing radiograph; a line is then drawn along the upper-end plates of the superior and inferior vertebrae (see Figure 1.3). The Cobb angle method of measurement was the first internationally recognised system for classifying curve patterns into single, double, or triple curves, although single curves are the most common type [38]. The results obtained from the measurement dictates the treatment and rehabilitation decisions. Based on these angular measurements there have been many different classifications proposed, but none of these systems today have widespread validity. However, there has been a consensus on some thresholds [39-43]:

- Under 10° of scoliosis, the diagnosis of scoliosis should not be made.
- Over 30° of scoliosis, the risk of progression in adulthood increases, as well as the risk of health problems and reduction of quality of life.

- Over 50°, there is a consensus that it is almost certain that scoliosis is going to progress in adulthood and cause health problems and reduction of quality of life.

The Cobb angle, when measured manually on the radiograph, has a measurement error of 5° [44-49]. However, new computer-assisted measurement methods have lesser measurement errors ranging from 1.22° to 3.6° [38]. When making clinical decisions, these measurement errors should be taken into account.

Vertebral rotation (torsion) is the extent to which each vertebra rotates into the convexity of a curve along the longitudinal axis of the spine [29]. The most commonly used technique for grading vertebral rotation (0-4) is the Nash-Moe method [50].

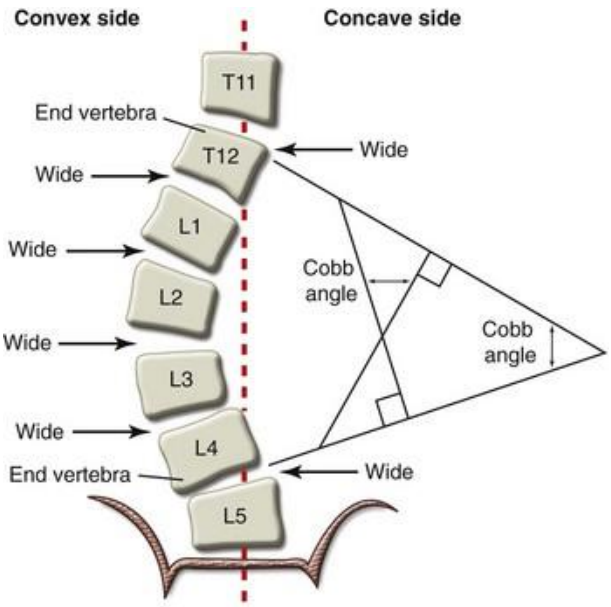


Figure 1.3 The Cobb angle method for measuring the size of spinal curvature (clinicalgate.com).

Topographic:

Topographic classification is based on the anatomical site of the spinal deformity in the frontal plane. Anatomical methods of classifying scoliosis also suffer from reliability and

validity problems. The Lenke classification has been proven to be more reliable than the King classification. The King classification describes spinal curvatures in only two dimensions, and surgical interventions based on this method are based on first-generation (i.e., outdated) surgical techniques and the inter-rater reliability is poor in comparison to the Lenke classisfication [51-53]. Anatomically, scoliosis can be classified according to the vertebral level of the deformity and extent of vertebral rotation. The vertebral level of deformity or 'curve pattern' in terms of lumbar (apex is between L1 and L4 lumbar vertebrae), thoracic (apex is between T1 and T11 thoracic vertebrae), thoracolumbar (apex at T12 thoracic or L1 lumbar vertebra) and double major (curves in which there are two curves that are [typically] of equal size) is the simplest and oldest method of describing scoliosis (developed by Ponseti)[54]. These curve patterns are presented graphically in Figure 1.4.

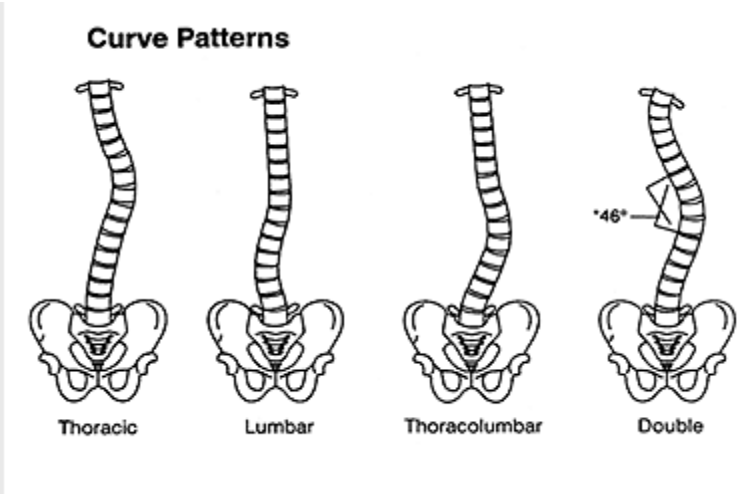


Figure 1.4 Curve patterns in people with idiopathic scoliosis (niams.nih.gov).

Classification methods based on age at onset, pathological, and anatomical factors are typically combined to describe scolioses, for example, adolescent (age of onset) idiopathic scoliosis (pathological) with a single thoracic curve measuring 35 degrees (anatomical).

1.6 Assessment, Screening and Diagnosis of Idiopathic Scoliosis

Since scoliosis is diagnosed as idiopathic only by exclusion, history taking is mandatory when assessing the patient clinically to determine possible congenital or neuromuscular aetiologies, as well as determining the severity of scoliosis and associated symptoms [55,56]. A family history of scoliosis is vital as certain types of scoliosis have a strong genetic influence [55,57]. To avoid curve progression and spinal deformity, early diagnosis, and treatment are essential. When left untreated, scoliosis may lead to severe complications and permanent spinal deformity [55].

The range of motion of the spine should always be tested to determine any decrease in range of motion due to scoliosis [55]. On anterior observation of the patient, the arms should hang equidistant from the waist. In the presence of scoliosis, one arm hangs closer to the body than the other [57]. A screening method that can be used is to drop a plumb line so that a line is formed which should pass over the spinous process of the seventh cervical vertebra and into the gluteal cleft. This line is referred to as the posterior line of reference and divides the body into left and right halves posteriorly. Any deviation of the spine from this line of reference indicates lateral deviation or scoliosis of the spine [55]. This assessment will only be able to indicate some form of spinal imbalance and cannot be used as the only test to diagnose structural scoliosis [55].

Due to aesthetics rating as the number one goal of treatment in a 2005 Consensus Paper published by SOSORT [39], the TRACE scale has also become a useful and non-invasive measurement tool. The TRACE scale is a 12-point scale based on a visual assessment of shoulders, scapulae, waist, and hemithorax asymmetries. Intra-rater repeatability was fair,

being the minimum significant change three out of twelve, while inter-rater reliability was poor being the minimum significant change four [58].

The main evaluation test in the clinical examination is the Adam's forward bending test, and a positive test result is pathognomonic for scoliosis [59]. Adam's forward bending test can be used to identify the presence of a curve that may require further radiographic examination [59]. The person will be required to bend over forwards from the waist while keeping the legs and arms straight with the palms together to perform the test [59]. This test will then be able to detect the angle of trunk rotation (ATR) and rib displacement (or 'rib hump' that gives the appearance of a humpback) that is characteristic of structural scoliosis [55,57,59,60]. Although, not universally in use, a scoliometer (a type of inclinometer) can be used to measure the ATR and rib hump which appears as a consequence of the Adam's forward bending test [29,59]; a reading of 7° degrees is considered a cut-off in a surgical setting and 5° degrees when prevention is desired through a good conservative approach [29,59]. The scoliometer reading has a sensitivity of about 100% and a specificity of about 47% when an ATI angle of 5° is chosen. At an ATI angle of 7°, sensitivity drops to 83%, but specificity rises to 86% [61,62]. The scoliometer has high interobserver reproducibility, which allows the determination of when a radiographic study, is indicated [56,59] (see Figure 1.5).

Figure 1.5 Depicts the position in which screening for scoliosis using Adam's forward bend test using a scoliometer. Notice the apparent posterior rib displacement (SpineUniverse.com 2019).

However, the above mentioned 'screening' tests are only reliable for detecting spinal imbalance or trunk asymmetry and are not the definitive diagnostic tool for idiopathic or other types of structural scoliosis, which require radiographic confirmation [59,63-65]. Radiographic examination remains the reference standard, but it is important to first use the evaluation tests above to ascertain the extent of ATR or rib hump, before ordering a radiographic examination and during regular follow-ups to reduce the complications associated with radiation exposure [56]. Consequently, standing posterior-anterior (back-front) radiographs are taken to confirm the presence of idiopathic scoliosis by measuring the Cobb angle, assessing extent of vertebral rotation, and to exclude underlying causes in order to rule out non-idiopathic scolioses, including a clear view of the pelvis to assess remaining skeletal growth potential (see Figure 1.6) [29].

Figure 1.6 Posterior-Anterior Radiograph of a single Right-Side Thoracic Curve (SpinUniverse.com 2019).

To conclusively diagnose IS, a patient must present with at least 10° of a lateral curvature on radiography as well as an unmistakable and measurable amount of axial rotation [200]. The angle of scoliosis measured on the standing frontal radiograph according to the Cobb method is one of the decisive factors in managing the condition, and in cases where the curve is under 10 degrees, the diagnosis of scoliosis should not be made [21]. In order to make a definite diagnosis of IS, the Cobb angle needs to be considered alongside a physical assessment and measurement of the structural rotation of the spine [2]. Cobb angle measurements on the same radiographic image had an intra- and inter-observer variability of 3-5° and 6-7°, respectively [66]; this classically reported error increases when the postural, and even diurnal changes in different exams are considered [66].

In addition, a posterior-anterior radiograph of the left hand is often performed to assess bone age (that may differ from chronological age) to further ascertain the remaining skeletal growth potential [29]. Future skeletal growth potential is widely considered the most important risk factor for the progression of curves in idiopathic scoliosis which would determine the urgency and extent of health care needed [220,67-69]. The importance of the remaining growth potential will be discussed further in Section 1.9.

According to Murphy and Rinsky [70,71], idiopathic curves 'typically' involve females, adolescents, absence of pain, normal neurological findings, and right thoracic patterns, as 90% of thoracic curves in adolescent idiopathic scoliosis are to the right [70,71]. Atypical curves involve males, infantile or juvenile-onset, presence of pain, left thoracic pattern and rapid progression, which may require further investigations such as Computer Tomography (CT) or Magnetic Resonance Imaging (MRI) scans combined with myelography (a dye injected directly into the spinal canal to yield a clearer image) to rule out any underlying cause that is indicative of a non-idiopathic curve [72,73]. These imaging methods can also be used to detect typical curves, although their cost and time to produce an image in comparison to plain radiographs prohibit their routine use.

Computer tomography has also been used to assess Cobb angle, trunk asymmetry, and extent of vertebral rotation, including changes in these variables [74]. The advantages of computer-based imaging systems are that they produce an almost instantaneous three-dimensional image of the back that can be viewed from any desired plane and, from a safety point of view, avoid exposure to potentially harmful radiation from follow-up radiographs that are necessary to monitor progression [75]. Nevertheless, plain radiographs are still needed to assess remaining skeletal growth that is crucial for management, as computer imaging techniques

suffer from reliability problems identical to those described in Section 1.5 for plain radiograph assessments of Cobb angles [29].

1.7 Risk of Curve Progression in Idiopathic Scoliosis

According to Theologis and Fairbank [76], the progression of curves can be considered slow (an increase of 5-10 degrees over 2-3 years but has not exceeded 20 degrees) or rapid (an increase of ≥ 5 degrees in a 4-6 month period or has become larger than 20 degrees). It is of paramount importance to establish the likelihood of curve progression, as this plays a crucial role in determining the most appropriate treatment and patient education on prognostic issues [77]. Therefore, indicators of progression (that are based on natural history studies of untreated idiopathic scoliosis) are utilised to achieve appropriate referral to orthopaedic specialists, and perhaps more importantly, to avoid unnecessary, costly, and emotionally demanding treatment [30,67,77].

The risk factors associated with curve progression are multi-factorial and include gender, age at diagnosis, type and severity of the curve, Cobb angle, vertebral level of deformity, and remaining future growth potential [68,79]. From 25% to 75% of curves found at screening may remain unchanged, whereas from 3% to 12% of curves may improve [79]. Females with idiopathic scoliosis have a 10-fold higher risk of curve progression than males with comparable curve magnitudes [69,80], although this risk parameter is only valid for curves > 30 degrees [67]. When the Cobb angle is 10 to 20°, the ratio of affected girls to boys is similar (1.3:1), increasing to 5.4:1 for Cobb angles between 20° and 30°, and 7:1 for angle values above 30° [40]. In terms of the vertebral level of deformity, thoracic and double major curves are associated with the highest risk of progression, followed by thoracolumbar (medium risk) and lumbar curves that carry the lowest risk of progression [67]. However,

minimal attention has been devoted to developing an algorithmic model of factors implicated in curve progression [81].

Future growth potential is widely considered the most important risk factor for the progression of curves in idiopathic scoliosis [67-69,220]. Factors predictive of remaining growth potential include menarche status in females, pubertal status (Tanner stage), and skeletal growth potential (Risser grade). Menarche status in females (onset of menarche typically occurs at ≥ 12 years of age) is a strong predictor of curve progression, with an estimated risk of 50% and 20% before and after menarche, respectively [67,80,82]. Tanner staging consists of five linear stages (1 = preadolescent to 5 = maturity) that represent pubertal development. Tanner, 1962, as cited in Burgoyne & Fairbank [30] is also highly predictive of curve progression. The adolescent growth spurt begins at Tanner stage 2 for females (aged 8-14 years) and stage 3 for males (aged 11-16 years), which are associated with the highest risk of progression [30,83].

Risser grading (an index of skeletal growth potential comprised of six linear stages [0 = no ossification to 5 = complete bony fusion] that represents the progress of ossification to the iliac apophysis, Risser, 1958) is the most commonly used indicator of future growth potential (Figure 1.7). Risser grades of ≤ 2 are associated with an approximately 50% risk of progression, whereas grades > 2 are associated with a risk of 20% [79]. The risk of progression as a function of the interaction between Risser grade and size of spinal curvature is also reported in the literature. Risser grades 0-1 in adolescents with curves < 19 degrees carry a 22% risk of progression; however, the same Risser grades in adolescents with larger curves (20-29 degrees) carry a 68% risk [84].

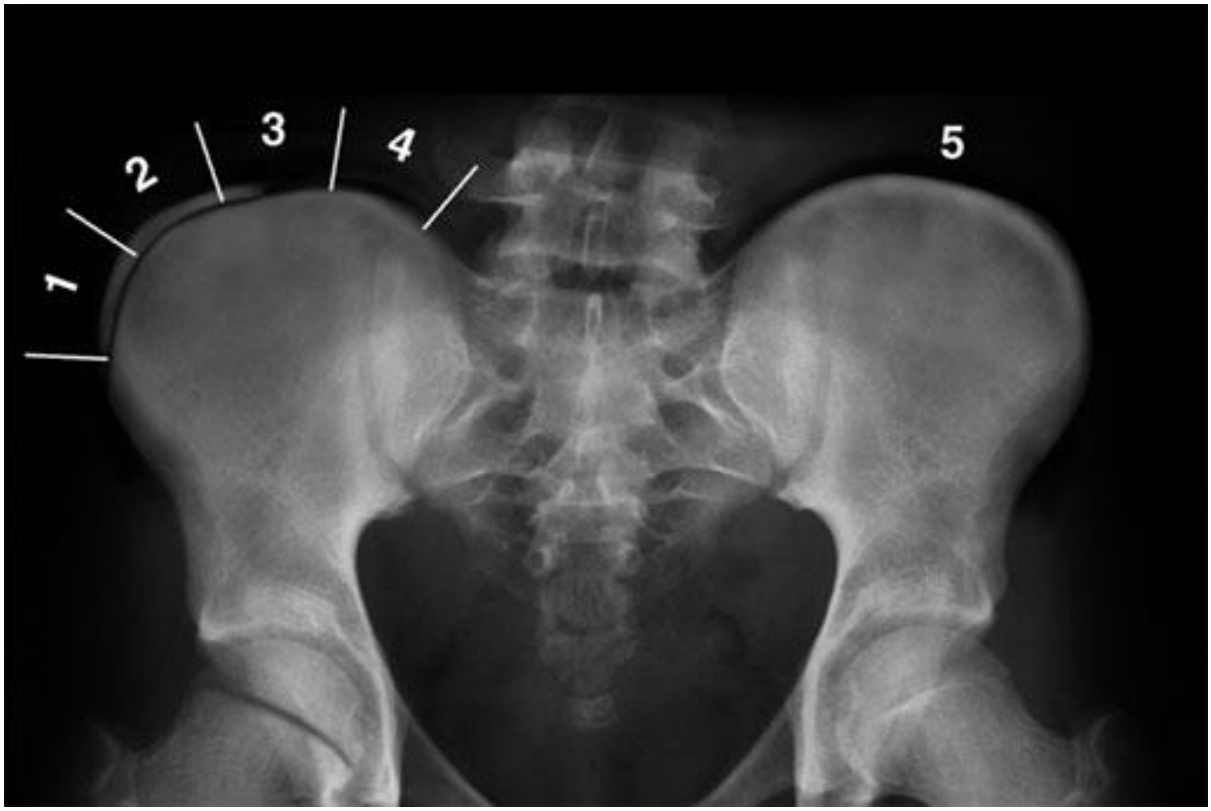


Figure 1.7 The Risser Grading system (Scoliosis Research Society).

The above guidelines for predicting the risk of curve progression based on the size of spinal curvature and Risser grading suffer from reliability and validity problems. Greiner [77] warned that when Risser's grade is incongruent with Tanner stage, menarche status, and chronological age, its predictive validity is diminished. Furthermore, Risser grade 4 in females has been questioned as a reliable marker of skeletal age, complete spinal growth, and curve progression, with chronological age being a more accurate indicator [78]. Moreover, many indicators of progression (Tanner stage, Risser grade, and Menarche status) are not applicable to the risk of curve progression in adults with scoliosis as they have achieved skeletal and biological maturity.

Once skeletal and biological maturity has been achieved, there is a lower risk of curve progression. However, 68% of curves in adolescence that have been reported to progress > 5 degrees after skeletal maturity [85] have the potential to progress further in the third or fourth

decade of life [86]. The size of spinal curvature is also predictive of curve progression in adults, with curves ≥ 60 degrees associated with an almost 100% risk of progression into adulthood [71]. Similarly, large thoracic curves at maturity (60-90 degrees) carry the highest risk of progression at a rate of approximately 1 to 1.5 degrees per year [36,85,86]. IS may also further intensify in adulthood as a result of progressive osseous deformities and collapsing of the spine [36,39,85,86]. This phenomenon is reported, especially in scoliosis, that is more severe than 50°, while the risk of progression starts to increase as the curve grows above 30° [39,87,88,89]. The natural history of adult scoliosis is not well known to date, and it is still possible the progression can have some peak periods [90]. If the scoliosis angle at completion of growth exceeds a "critical threshold" (most authors assume it to be between 30° and 50° [91], there is a higher risk of health problems in adult life, decreased quality of life, cosmetic deformity and visible disability, pain and progressive functional limitations [39,40].

1.8 Conservative Treatment of Idiopathic Scoliosis

SOSORT experts have defined that the goals of conservative treatment of IS may be divided into two groups: morphological and functional. The first aspect is related to aesthetics, which was defined as the first goal of treatment. Both aspects are related to patients' quality of life, psychological well-being, and disability (defined as the second, third, and fourth goals according to the SOSORT experts) [39]. The basic objectives of comprehensive conservative treatment of Idiopathic Scoliosis have been described as the following: (1) to stop curve progression at puberty (or even reduce it), (2) to prevent or treat respiratory dysfunction, (3) to prevent or treat spinal pain syndromes, (4) to improve aesthetics via postural correction.

Evidence-based clinical practice should dictate the rehabilitation approach/procedures and is, by definition, the best integration between the knowledge offered by evidenced-based

medicine, individual clinical expertise, and patients' preferences [92-94]. Consequently, different clinicians will treat a patient with the same clinical problem differently; the variation can be due to the patient's preferences or because of the specific expertise of the clinician. Therefore, proposing a definitive clinical approach for a particular clinical situation is problematic. Instead, a range of options should be considered.

Observation is the first step to an active approach to IS, and it consists of regular clinical evaluation and follow-up period. Although not a treatment *per se*, active monitoring without referral to an orthopaedic specialist (but with regular radiological examinations every 6-12 months) is recommended for patients aged <12 years with small (≤19 degrees) idiopathic curves [68,82], this is primarily due to the low risk of curve progression associated with curves of this size [67,70,78,79]. Curves that progress significantly should be considered for bracing, surgery, or both [30].

Bracing consists of using a brace (a corrective orthosis) for a specified period of time each day. Usually, it is worn until maturity. The main therapeutic goal is to halt the scoliosis curves from progression. Bracing has been recommended as a treatment and the first step in an attempt to avoid or at least postpone surgery to an adequate age in juvenile and infantile IS. Unless otherwise justified in the opinion of a clinician specialised in conservative treatment of spinal deformities, it is recommended not to apply bracing to treat patients with curves below 15 ± 5° Cobb [2,21,107-111]. Bracing is recommended and should be applied to treat patients with curves above 20 ± 5° Cobb, still growing, and demonstrated the progression of deformity or elevated risk of worsening, whether this is through their age, maturity level, degree of angle or physical characteristics [2,21,107-111]. According to SOSORT, the use of a rigid brace implies the use of exercises when out of the brace. Bracing

is considered appropriate for skeletally immature individuals with remaining spinal growth and curves in the range of 20 to 40 degrees that have progressed > 5 degrees in a 6-month period [30]. Dolan demonstrated in a multi-centre RCT that bracing is effective at preventing progression to the surgical range (defined as ≥ 50°) [95]. The different bracing techniques that are being used include night-time rigid bracing, soft bracing, part-time rigid bracing, and full-time rigid bracing. With night-time rigid bracing, the brace would be applied for 8-12 hours per day and constitutes wearing a brace mainly in bed. The SpineCor brace [96,97] is mainly used in soft bracing, but there are also other similar designs [98,99]. Part-time rigid bracing involves wearing a brace mainly outside the school and in bed for 12-20 hours per day. When full-time rigid bracing is prescribed, the brace will be worn for 12 -20 hours per day. It involves wearing a rigid brace all the time (at school, at home, in bed, etc.). Casts have also been included and can be used by some schools as the first stage to achieve correction and to be maintained afterward with a rigid brace [100-102]. Casts have been considered a standard approach in infantile scoliosis [103-106]. Due to the actual knowledge, there is no brace that can be recommended over the other; therefore, it is recommended that each treating team provide the brace that they know best and are most confident to manage [2,21,107-111].

SOSORT supports the conservative treatment of all spinal deformities, which includes bracing and “Physiotherapeutic Scoliosis-specific Exercise (PSSE)” to try and limit curve progression and avoid either having to wear a brace or have fusion surgery [2,112,113]. PSSE can also help prepare the child for surgery [2,112,113]. PSSE is part of a scoliosis care model that includes scoliosis specific education, scoliosis specific physical therapy exercises, observation or surveillance, psychological support, and intervention, bracing, and surgery [114]. To systematise exercises for IS, the SOSORT drew up a consensus document on

physiotherapeutic management [2]. The term PSSE was defined according to evidence-based medicine guidelines. In order to recognise a particular physiotherapeutic method as being specific for IS, it has to demonstrate usefulness in treating children, adolescents, and adults with the condition, ie, an influence on the curvature angle, improvement in cardiorespiratory parameters, reduction or abolition of pain, and improvement in body aesthetics and quality of life [2,112]. Moreover, each method should comprise three-dimensional correction of deformity with the focus on restoration of spinal curvature in the sagittal plane, stabilisation of actively corrected body posture, training individuals in how to maintain the corrected body posture while performing activities of daily living and patient education [2,112]. PSSE has to be adapted to the individual curvature pattern of the child and the treatment phase. Individually tailored therapy should be revised regularly and systematically [2,112,115]. There are several methods that can be used for PSSE, which meet the abovementioned criteria[2,39,114] and have been approved by SOSORT. The schools are presented in the historical order in which they were developed. They include the Lyon approach from France[114], the Katharina Schroth approach from Germany [114], the Scientific Exercises Approach to Scoliosis from Italy[114,116], the Barcelona Scoliosis Physical Therapy School approach (BSPTS) from Spain [114], the DoboMed approach from Poland [114], the Side Shift approach from the United Kingdom [114,117] and the Functional Individual Therapy for Scoliosis[114] from Poland.

A number of publications indicate the positive influence of PSSE on the course of scoliosis [2,3,118-123]. The PSSE administered at the different schools are based on various strategies of therapeutic management and differ in terms of methodologic assumptions, duration of the performance, the number of days a week they are done, and the way they are performed, i.e., with a physiotherapist or individually [2,124-131].

The exercises can slow the progression (deterioration) of scoliosis and/or reduce curve severity measured by the Cobb angle [114,124,125,128,132,133]. Studies have also shown a reduction in the risk of progression in comparison with the natural history of IS [33,127,134-136,221], improvement in neuromotor control, [137,138] back muscle strength, cosmetic appearance [139] and fewer patients requiring surgical treatment [140]. IS has been associated with various respiratory and physical capacity impairments [141-144], and PSSE can be beneficial in improving cardiovascular parameters via symmetrical and asymmetrical breathing exercises [2,145-147]. In the past several systematic reviews, including a Cochrane systematic review on the effects of exercises for scoliosis [126,148-151], reported promising results but highlighted the need for more and better-designed studies to enhance the evidence base. Since then, four randomised controlled trials (RCTs) have been done [3,121-123], which are generally recognised as the highest level of evidence for primary studies and indicated that PSSE could be effective in treating AIS patients with mild and moderate curves. The four RCTs were conducted in different parts of the world – in Italy by Monticone et al.[121](2014), in Canada by Schreiber et al.[3] (2015), in England by Williams et al. 2015 [122], and in Turkey by Kuru et al. [123] (2015). These RCT studies have indicated that PSSE can play an essential role in helping IS patients, and SOSORT has encouraged more studies of high quality to be produced [2].

Education also forms part of the treatment and involves explaining to children, parents, caregivers and adult scoliosis patients the nature of the disease together with its possible course and potential consequences, realistic therapeutic objectives, rules while performing physical (including home-based) exercises, and cooperation with the physiotherapist and physician supervising the treatment. Actively involving the patient and caregiver in all aspects of the rehabilitation programme is emphasised [152,153].

1.9 Sports Activities in Idiopathic Scoliosis

One of the goals of rehabilitation is to improve and sustain healthy psychological well-being and self-image in IS patients. The psychological and social aspects are shown to be related to the patient's self-image [154]. It has also been reported that persons with scoliosis who exercise regularly, show higher self-esteem, and have better psychological outcomes [155]. Therefore, SOSORT also recommends patients with scoliosis to remain active in sports activities, especially since participation does not seem to affect the occurrence or degree of scoliosis [156]. Despite this, sports activities and PSSE have different aims. While PSSE was developed to specifically target scoliosis deformity, postural control, and functional impairments [113,157-159], sports activities have a more general aim targeted at improving overall fitness and wellness. SOSORT, however, recommends that sport is not prescribed as a treatment for IS but recommends that general sports activities are performed because of the specific benefits they offer to patients in terms of psychological, neuromotor, and general organic well-being. It is recommended that, during all treatment phases, physical education at school is continued. Based on the severity of the curve and progression of the deformity and the opinion of a clinician specialised in conservative treatment of spinal deformities, restrictions may be placed on practicing certain types of sports activities. SOSORT further recommends that sports activities are continued during brace treatment but that contact or highly dynamic sports activities must be performed with caution and that competitive activity that highly mobilises the spine are avoided in patients with scoliosis at high risk of progression [2].

In a recent survey of the Spinal Deformity Study Group, which included 23 spinal surgeons, it was reported that, on average, modern posterior instrumentation is associated with earlier recommendations for return to sports after fusion for AIS. While the majority of surgeons allowed running by 3 months, noncontact and contact sports by 6 months, and collision sports

by 12 months, approximately 20% never allowed a return to collision sports, regardless of the surgical method used. However, all surveyed surgeons allowed eventual return to contact and noncontact sports regardless of construct type [160].

1.10 Incidence and Prevalence of Idiopathic Scoliosis

An Internet search of seven databases (PubMed, Medline, Cinahl, Pedro, SCOPUS, Cochrane Library, Google Scholar) in 2017 and again in 2019 was done to investigate the incidence and prevalence of idiopathic scoliosis in South Africa. The keywords that were used in the search: Scoliosis; Idiopathic Scoliosis; IS; South Africa; SA; South Africa AND IS; physiotherapy AND IS; physical therapy AND IS; clinical signs AND IS; risk factors AND IS; assessment of IS; knowledge of IS; Physiotherapists knowledge of IS; survey AND knowledge of IS.

Three studies were identified on the prevalence of IS in Africa [55,161,162]. The first study was conducted in the year 1974 in Johannesburg, South Africa's capital and biggest city. The study was on the incidence of idiopathic scoliosis in black and white population groups in Johannesburg [161]. The study identified different prevalence rates of 2.5% and 0.03% found among Caucasian and Black South Africans, respectively, which also points to the possible influence of racial categorisation on the prevalence of adolescent idiopathic scoliosis [161].

The next study was conducted in 2006 to determine the incidence of scoliosis in school children within the metropolis of Johannesburg, South Africa [163]. This was a case study approach, incorporating the clinical screening of 694 primary school children (sixteen government and sixteen independent primary schools) aged ten to eleven years, of all races and both genders in the metropolis of Johannesburg, South Africa [163]. Children involved in the study were screened for scoliosis using two methods, namely Adams' Position (Adam's forward bend test) and the Erect Position using a vertical plumb line [55,57,60,163,220]. These 'screening' tests are only reliable for detecting trunk asymmetry and are not the

definitive diagnostic tool for idiopathic or other types of structural scoliosis, which require radiographic confirmation [63-65]. The study concluded that 8.2% of the children screened were diagnosed with scoliosis, and 1.4% of these children had rib involvement due to potential structural scoliosis confirmed by the Adams' forward bend test [163]. The incidence of scoliosis, including all forms of the disease, was found to be far more significant in the primary schools of Johannesburg than what statistics for the United States and world incidence indicated. Scoliosis was found to be most prevalent in independent primary schools and in White children, with socio-economic status having a seemingly strong influence on the prevalence of scoliosis. The male to female ratio of scoliosis was found to be statistically equal [163].

The most recent study conducted in 2011, was done in Africa in Ibadan, the largest and the third most-populated city in Nigeria [164]. Nine hundred and ninety-nine (999) students (514 boys, 485 girls) aged 10-20 years (X=14.14±1.69 years) formed part of the study group. Fifty-three (5.3%) of the subjects had visually recognisable scoliosis. The male to female prevalence ratio was 1.5:1. All but one subject with scoliosis were right-handed while 26 (51%), 23 (49%) and 4 (7.5%) of them had right thoracic, left thoracic and left lumbar scoliosis respectively. Twenty-five subjects (2.5%) were twins but 3 (12.0%) of them had scoliosis [164]. The study concluded that the prevalence of idiopathic scoliosis among adolescents in this study is similar to rates reported among similar age groups in other parts of the world. The authors of the Nigerian study suggested a need for a national survey of idiopathic scoliosis and institutionalisation of the school screening programme in Nigeria [164]. Screening is a highly contentious issue and detractors claim that it leads to increased costs, over referral, unnecessary radiation exposure, and treatment (primarily due to the relatively low rate of curves that actually require medical intervention) [162], although

proponents argue that early detection is the key to successful management of idiopathic scoliosis [165-170].

Infantile idiopathic scoliosis is more common in males than females [70], whereas the incidence of juvenile and adolescent idiopathic scoliosis is substantially higher in females than males with ratios of 7:1[171,172] and 10:1 [173,174] being reported in the literature. The prevalence of idiopathic scoliosis in the USA is reported to be 2-4% of children aged 10-16 years [174]. Adolescent idiopathic scoliosis (AIS) accounts for the majority of cases with infantile and juvenile accounting for only 1% and 12%-21% of all cases, respectively [87-89,165-168,175-186]. AIS with a Cobb angle above 10° occurs in the general population in a wide range of prevalence from 0.93 to 12% [87-89,166-168,178-181,187,188]. Approximately 10% of the cases diagnosed with IS require conservative treatment and approximately 0.1-0.3% require an operation to correct the deformity [84]. In terms of size of spinal curvature, the prevalence of idiopathic scoliosis in adolescence is 1.5%-3%, 0.3-0.5% and 0.2-0.3% for curves of > 10, > 20 and > 30 degrees respectively [84]. Two to three percentage is the value most often found in the literature, and it has been suggested that the incidence changes according to latitude, with higher values reported in countries located further north from the equator [177,188]. Researchers attribute this due to the late age at menarche of girls that live in northern latitudes, which therefore prolongs the period of spine vulnerability while other pre-existing or aetiological factors are contributing to the development of adolescent idiopathic scoliosis [188].

Historically, infantile, juvenile, and adolescent idiopathic scolioses have received the most attention in the literature, although with increasingly ageing populations in the West and a focus on the quality of life issues, adult scoliosis has become a higher priority in healthcare [36,189]. The estimated prevalence of adult scoliosis in the general population is in the range of 0.0002% to 12% [190,191]; however, this figure is likely to be higher, as few large-scale

epidemiological studies have been conducted. Schwab et al. [192] reported a prevalence rate of 68% in asymptomatic adults aged ≥ 60 years [192].

1.11 Knowledge on Idiopathic Scoliosis

Every physiotherapy scoliosis approach or 'school' around the world subscribe to SOSORT's principles and shares a common mission [114]. The shared goal is not simply to look at the spine in the coronal plane but to look at the affected individual and family under a more holistic psychosocial model, where present and future quality of life is the main objective [114]. In order to achieve this goal, the health care professional working with the IS patient and family need to be fully versed in the most up to date research and knowledge on the subject.

Due to IS being a progressive disorder, it is imperative that health care practitioners have adequate knowledge to recognise potential IS patients, provide adequate screening, diagnosis, management, education, and the appropriate referral. There has been much debate and controversy regarding the screening process of IS patients even though early detection is of the utmost importance in these progressive disorders. An Internet search of seven databases (PubMed, Medline, Cinahl, Pedro, SCOPUS, Cochrane Library, Google Scholar) in 2017 and again in 2019 demonstrated that worldwide there have been three surveys [193-195] conducted to ascertain the knowledge of IS among physiotherapy students and one on adolescent idiopathic scoliosis (AIS) among family physicians, paediatricians, chiropractors and physiotherapists in Québec, Canada [196]. The three surveys that examined the Physiotherapy students' knowledge and management of IS were done in Poland, the USA, and the United Kingdom respectively [193-195].

The first study was conducted in 2008 by Ciazynski et al. [193] in Poland. The study included 37 students from the Medical University of Silesia (aged 22-25), attending the third year of a

first degree of physiotherapy. All students had credits in kinesiotherapy, including methods of conservative treatment of IS. Students were examined using a questionnaire, comprising general knowledge of IS, questions related to sagittal plane correction, influence of various physical activities on IS and known methods of conservative treatment. 81% of the students considered IS as a 3-D deformity. 62.2% of those questioned would diagnose IS when the Cobb angle reaches 10 degrees. All students agreed that the aetiology of IS remains unknown. Questioned students mostly preferred swimming (94.6%), yoga (73.0%) and martial arts (32.4%) as beneficial to IS. The methods of conservative treatment which were known best were: Lehnert-Schroth-Weiss (94.6%), Klapp (91.9%), Majoch (89.2%) and Dobosiewicz (78.4%). The study concluded that the average level of knowledge among the students of physiotherapy is unsatisfactory, despite the education programme including the SOSORT guidelines. Education in the field of scoliosis should be more comprehensive and cover the current SOSORT guidelines[193].

In 2014 Drake et al. designed a 10-question multiple choice survey to determine the basic knowledge of idiopathic scoliosis in one hundred and seventy-eight (178) physical therapy students trained in the United States [194]. One hundred and thirty (130) randomly selected physical therapy schools that offer the Doctor of Physical Therapy degree in the United States consisted of the sample for the study. Students were examined using a questionnaire, comprising general knowledge of IS, questions related to sagittal plane correction, influence of various physical activities on IS and known methods of conservative treatment [194]. The results from the study indicated that only fifteen students (8%) answered more than 70% of the survey questions correctly with a mean overall score from the sample of 43% [194]. As a result, compared to the Ciazynski et al. [193] study the students generally performed worse, with only twenty-nine percent (29%) correctly indicating scoliosis is a three-dimensional

deformity versus eighty one present (81%) in the Ciazynski et al. study and twenty percent (20%) knew how to confirm the diagnosis compared to sixty-two (62%) in the Ciazynski et al. study. In the study by Drake et al. [194] most of the students were not familiar with any conservative treatment methods, whereas most students (94.6%) were aware of at least one conservative treatment method in the study by Ciazynski et al. [193], who recommended that the education provided to physiotherapy students on scoliosis should be comprehensive and cover the current SOSORT guidelines [193].

The study conducted by Blake et al. in 2017 had one hundred and sixty-five (165) completed questionnaires from UK physiotherapy students, spread across twelve (12) different universities, who were in their penultimate or final year for either a bachelor's or master's physiotherapy degree [195]. When comparing this study with previous studies on the topic, the Blake et al. study performed worse in relation to their USA counterparts in all areas except when asked, 'What should treatment of Idiopathic Scoliosis using therapeutic exercise include?', six percent (6%) answered correctly compared to three percent (3%) in the American study [194].

All three of the studies concluded that there is an unacceptable level of knowledge on scoliosis amongst physiotherapy university students [193-195]. SOSORT encourages all health care professionals working with scoliosis to keep up to date, be educated to the appropriate standard and to be proficient with the most recent research and information available on the subject. SOSORT also releases regular orthopaedic and rehabilitation treatment guidelines on IS to help practitioners [2,21].

1.12 Conclusion

Idiopathic scoliosis is a complex musculoskeletal disorder with an unconfirmed multi-factorial aetiology. Despite an internationally accepted definition, there is no universally accepted method of classification. Moreover, classification systems based on age at onset, pathological and anatomical criteria present with serious reliability and validity problems. Undoubtedly, this has contributed to an uncoordinated approach to medical research on idiopathic scoliosis. This may also account for the cause of idiopathic scoliosis remaining elusive, with suspected causes regarded as epiphenomena as opposed to established causes. Reliable and valid data on curve progression are crucial for the treatment of idiopathic scoliosis. Unfortunately, there is no reliable and valid 'progression algorithm' that takes into account the myriad of factors implicated in curve progression in children, adolescents, and adults.

There have only been two studies conducted on the incidence of scoliosis in SA and both these studies were conducted in Johannesburg. The most recent study conducted in 2006 concluded that the incidence of scoliosis was far more significant in the primary schools of Johannesburg than what statistics for the United States and world incidence indicated.

An essential requirement for a physiotherapist is to be proficient in the management of musculoskeletal related conditions such as scoliosis and other spinal deformities. Therefore, when children and adolescences seek care for musculoskeletal related conditions, they will very often seek help from a physiotherapist, and with an increase in self-referral to physiotherapy, the likelihood of a physiotherapist being the first point of contact for a patient with scoliosis is increased [197]. In SA, registered physiotherapists have first line practitioner status which means that the public does not require a referral to be seen by a physiotherapist which further increases the likelihood of a physiotherapist being the first point of contact for a patient with scoliosis. If adolescent idiopathic scoliosis (AIS) is detected early, it can lead

to better decision making regarding the course of conservative treatment and whether surgery can be avoided [198]. Due to IS being a progressive disorder early detection and identification is very important in improving the prognosis of the IS condition. Studies have shown that AIS cases that are undiagnosed could lead to severe morbidity, and in extreme cases, mortality [199]. As already discussed, numerous publications have indicated that physiotherapists who implement PSSE to their scoliosis clients can have a positive influence on the course of scoliosis. Compared to other 'more serious' health problems such as HIV/AIDS, diabetes, obesity, heart disease, and cancer, idiopathic scoliosis in South Africa has received a low priority in the healthcare system.

The three previous studies conducted in Poland, USA and the United Kingdom that assessed the knowledge of idiopathic scoliosis among physiotherapy students concluded that the knowledge was unacceptable. To date and to the authors' knowledge, there has never been a study done to assess the basic knowledge of idiopathic scoliosis among practicing physiotherapists in South Africa.

The literature review led to the formulation of the following research question and objectives:

Research question:

What is the current level of basic knowledge on idiopathic scoliosis among registered practicing physiotherapists that are interested in orthopaedic, muscular, manual or manipulative therapy in South Africa?

Objectives:

- Evaluate and describe the basic knowledge of physiotherapists that are interested in the orthopaedic, muscular, manual or manipulative therapy of clients regarding the screening, education, and scoliosis specific exercise prescription for self-referring patients with IS.
- Comparing whether there is a difference in the current basic knowledge on IS among physiotherapists that are registered with the OMPG and the physiotherapists that are not registered with this group but who are interested in orthopaedic, muscular, manual or manipulative therapy.
- To identify knowledge gaps regarding IS that need to be addressed.

Chapter 2

METHODOLOGY

2.1 Introduction

This chapter details the study design, setting, population, procedures, study objectives, data management, study procedures, data analysis, and statistical analysis that were undertaken in order to answer the research question. The ethical and legal considerations of the study are also discussed in this chapter.

2.2 Study Aim and Objective

The aim of this project was to ascertain the current level of knowledge on Idiopathic Scoliosis (IS) among registered practicing physiotherapists in South Africa.

The study objectives were:

- Evaluate and describe the basic knowledge of physiotherapists interested in orthopaedic, muscular, manual or manipulative care regarding screening, education, and scoliosis specific exercise prescription for self-referring patients with IS.
- Comparing whether there is a difference in the current knowledge among physiotherapists that are registered with the OMPG and the physiotherapists that are not registered with this group but who are also interested in orthopaedic care.
- To identify knowledge gaps regarding IS that need to be addressed.

2.3 Study Design

This is quantitative research, a descriptive study using an online survey for data collection was conducted to address the research objectives. This design was a feasible, cost-effective approach when information should be collected from a relatively large cohort of participants. Since the aim was to obtain national data, an online survey was the most pragmatic mode to collect data.

2.4 Project Outline

The study outline is summarised in the figure below:

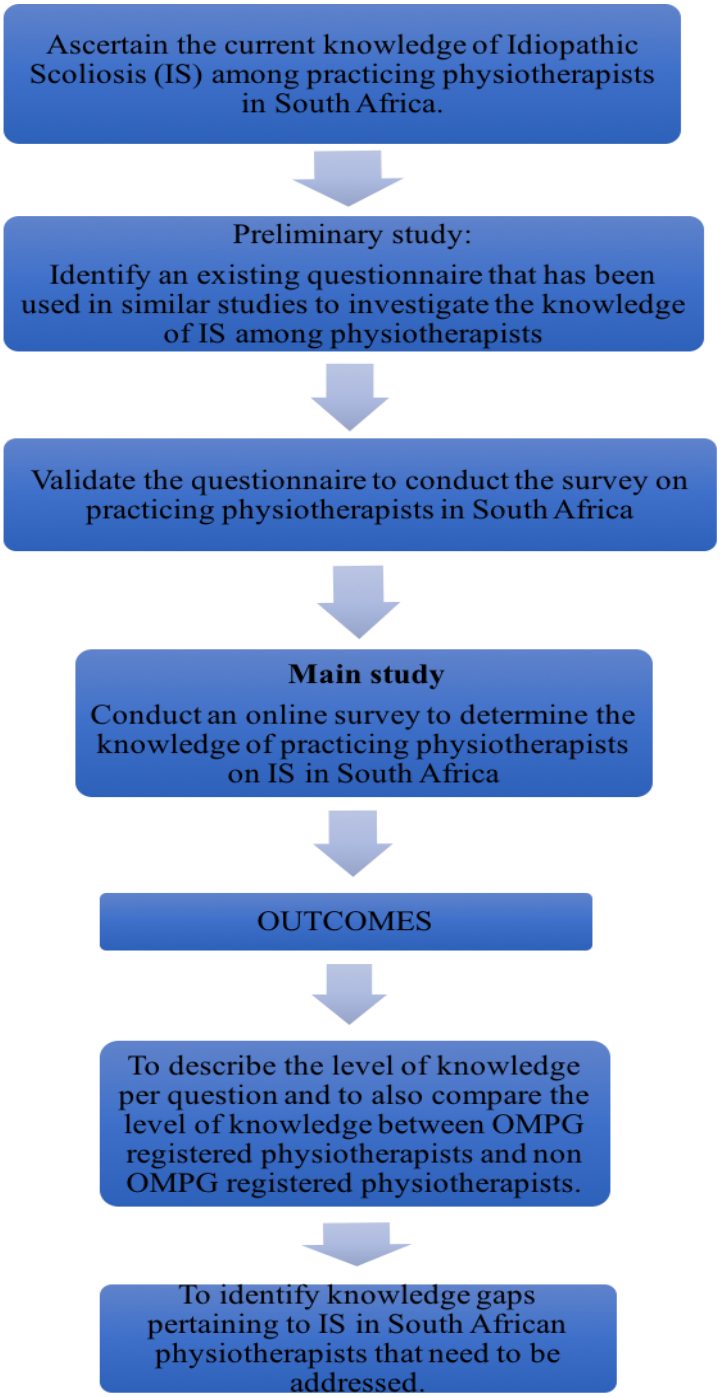


Figure 2.1 Flow diagram demonstrating the study outline and procedures

2.5 Questionnaire Development

2.5.1 IDENTIFICATION OF A POTENTIAL QUESTIONNAIRE:

An Internet search of seven databases (PubMed, Medline, Cinahl, Pedro, SCOPUS, Cochrane Library, Google Scholar) in 2018, delivered two questionnaires. The keywords that were used in the search: Scoliosis, Idiopathic Scoliosis, IS; physiotherapy AND IS; physical therapy AND IS; clinical signs AND IS; risk factors AND IS; assessment of IS; knowledge of IS; Physiotherapists knowledge of IS; survey AND knowledge of IS.

The search identified two questionnaires: the one questionnaire [193-195] was used to investigate the knowledge of IS among physiotherapy students and the other questionnaire was used to identify the knowledge of adolescent idiopathic scoliosis (AIS) among family physicians, paediatricians, chiropractors and physiotherapists [196]. The three studies that focused on investigating the knowledge among physiotherapy students utilised the same questionnaire [193-195]. The earliest questionnaire was used to conduct a survey on the knowledge about IS among students of Physiotherapy in Poland [193]. This questionnaire was then modified and used in a similar survey on the knowledge of idiopathic scoliosis among physical therapy students in the USA [194], and then the same questionnaire was again used in a similar survey on the current knowledge of scoliosis in physiotherapy students trained in the UK [195]. The other questionnaire was developed to investigate the knowledge and management of Adolescent Idiopathic Scoliosis among family physicians, paediatricians, chiropractors and physiotherapists in Québec, Canada [196]. This survey had a small sample size of 51 participants and conducted telephonic interviews.

The initial questionnaire that was modified and used in the survey conducted on physical therapy students in the USA [194] and the physiotherapists trained in the UK [195] was selected for this study. This questionnaire was selected because it proved to be the most

suitable for this survey as it was testing the knowledge of idiopathic scoliosis in Physiotherapy students.

2.5.2 QUESTIONNAIRE CONSTRUCTION:

The first part of the questionnaire included questions to obtain the demographic information from the participants and included questions on whether they are a OMPG member, interested in orthopaedic, muscular, manual or manipulative therapy, the province they practice physiotherapy, year qualified, post graduate qualifications and the amount of years practicing physiotherapy.

Permission was requested and granted from Drake et al. [194] to utilise a similar questionnaire in this study to investigate the current knowledge of physiotherapists in South Africa on Idiopathic Scoliosis. Drake et al. [194] completed the development of a questionnaire using a theoretical framework from a previously completed survey by Cziazynski et al. [193] and utilising the information provided within the 2011 SOSORT guidelines [2].

The survey consisted of 10 multiple-choice questions. The first seven multiple-choice questions tested the knowledge of physiotherapists on IS based upon the 2011 SOSORT Guidelines [2]. These questions assessed different aspects of idiopathic scoliosis and were divided into the following categories: definition, cause, development, prevalence, diagnosis, treatment, and bracing.

The last three multiple-choice questions consisted of survey questions to determine the physiotherapists' opinions about:

1) types of physical activity that would be beneficial/harmful to patient’s scoliosis,

2) familiarity with types of conservative treatments for IS (see Table 2.1).

Table 2.1: Survey Questions and Categories

Definition	1. What is idiopathic scoliosis?
Cause	2. What causes idiopathic scoliosis?
Development	3. When does idiopathic scoliosis commonly develop?
Prevalence	4. How prevalent is idiopathic scoliosis among scoliosis patients?
Diagnosis	5. How is the diagnosis of idiopathic scoliosis commonly confirmed?
Treatment	6. The treatment of idiopathic scoliosis using therapeutic exercise should include?
Bracing	7. When is bracing recommended for patients with idiopathic scoliosis?
Physical Activity and Its Influence	8. What physical activity do you think would be most beneficial to patients with idiopathic scoliosis?
Physical Activity and Its Influence	9. What physical activity do you think would be most harmful to patients with idiopathic scoliosis?
Familiarity	10. What method of conservative treatment of idiopathic scoliosis are you most familiar with?

The initial questionnaire (Appendix E) was reviewed and validated by a panel consisting of three experienced researchers/musculoskeletal lecturers in South Africa. The panel included Dr Ina Diener. Dr Elzette Korkie and Mr Carel Viljoen. Dr Ina Diener is an internationally experienced clinician and lecturer who obtained her Ph.D. in 2003. She has been in private practice for more than 30 years and started teaching undergraduates in 1990. Since 2003 she has been involved with the orthopaedic manual therapy modules of masters' programmes at

Stellenbosch University and the University of the Western Cape and the study leader for many post-graduate students in the field. She has been the chair of the OMPG and currently the Deputy President of the SASP. Dr Elzette Korkie is an experienced lecturer and clinician from the University of Pretoria with over 20 years of experience. Dr Korkie is the deputy head of the department and undergraduate programme manager at the University of Pretoria. She qualified with her Ph.D. degree from Pretoria, and her expertise is in the Musculoskeletal area. Mr Carel Viljoen obtained his masters in Sports Physiotherapy from the University of the Free State and is actively lecturing in this field at the University of Pretoria.

The same questionnaire has been used to assess the knowledge of physiotherapy students in USA and in the United Kingdom. Face validity was established and the panel confirmed that the same questionnaire will provide an overview of the knowledge on idiopathic scoliosis among physiotherapists in SA and included five additional questions (Table 2.2) aimed at investigating the physiotherapist's confidence in the screening, assessment, management and education of a scoliosis patient:

Table 2.2: Additional survey questions

Evidence-Based Research	11. According to evidence-based research, what has proven to be the most effective form of conservative management in idiopathic scoliosis?
Screening	12. Would you feel confident using Adam's forward bend test and the Scoliometer?
Educational Support/Confidence	13. Would you feel confident providing educational support to a client presenting with idiopathic scoliosis?
Management confidence	14. Would you feel confident in the management of a client with idiopathic scoliosis?
Opinion	15. Do you feel scoliosis specific physiotherapy exercise interventions can be beneficial in the management of idiopathic scoliosis?

The results from the five additional questions will not be analysed in depth by the current study but can be used for future research.

2.6 Study Population

Physiotherapists that are registered with the Health Professions Council of South Africa (HPCSA) and interested in the orthopaedic, muscular, manual or manipulative therapy/management of clients. Any physiotherapist that wishes to practice physiotherapy in South Africa needs to be registered with the HPCSA. All OMPG members need to be registered with the HPCSA and the South African Society of Physiotherapy (SASP) group. The practicing physiotherapists registered with the above groups comprised the study population.

2.7 Inclusion and Exclusion Criteria

2.7.1 INCLUSION CRITERIA:

Registered physiotherapists younger than 75 years of age who are actively practicing physiotherapy in any of the nine provinces of South Africa and that are interested in the orthopaedic, muscular, manual or manipulative therapy/management of clients.

2.7.2 EXCLUSION CRITERIA:

Under-graduate physiotherapy students were not eligible to participate in the study and their responses were excluded.

Physiotherapists that submitted their responses later than July 2019.

2.8 Sample Size and Sampling

On 19 June 2019, a total of 1361 physiotherapists in South Africa were members of the OMPG. The study population were all members of the OMPG and physiotherapists that are not members of the OMPG but interested in the orthopaedic, muscular, manual or manipulative therapy/management of clients. We sampled across all provinces, and all physiotherapists who met the inclusion criteria were invited to participate (population sampling). Two hundred and thirty-seven (237) physiotherapists completed the questionnaire. Nine (9) physiotherapy students and three (3) physiotherapists who indicated that they are not interested in the orthopaedic, muscular, manual or manipulative therapy/management of clients were excluded as they did not meet the inclusion criteria. A further two (2) physiotherapists (one OMPG member and one non-OMPG members) completed the questionnaire after the cut-off date (31 July) and was excluded from the study.

Two hundred and twenty-three (223) Physiotherapists spread across the 9 different provinces/regions of South Africa met the inclusion criteria and formed part of the study. One

hundred and sixteen (116) of these physiotherapists are members of the OMPG, and the other 107 physiotherapists are not members of the OMPG but indicated on the questionnaire that they are interested in the Orthopaedic, Muscular, Manual or Manipulative therapy of clients.

2.9 Recruitment

The study was advertised in the South African orthopaedic manipulative physiotherapy newsletters as these newsletters would attract attention from OMPG physiotherapists and physiotherapists that are not members of this group but interested in the orthopaedic, muscular, manual or manipulative therapy/management of clients (Appendix A). The newsletters contained an online link to the information leaflet, consent form, and questionnaire (Appendices B and C). The study was published in these newsletters as the study wanted to attract members of the OMP group as well as physiotherapists who do not belong to this group but who also share an interest in the musculoskeletal and orthopaedic fields. To encourage participation in the study every participant that completed the questionnaire stood a chance of winning a cash price of R 1500 in a lucky draw competition. These methods of advertising attracted a diverse group of actively practicing physiotherapy populations of different ages, backgrounds, experiences, with the aim to reduce selection bias and sampling error.

2.10 Data Collection

The reviewed and validated questionnaire, which consisted of 15 multiple choice questions, was transcribed onto an online platform, and the survey monkey program was used to present the information and capture all the responses. The survey monkey program is user-friendly and accurately collects all the information entered from the participants and therefore was the

ideal software program to use for the current research study. In the survey monkey program, the elected survey program was set to only allow singular responses from the same device, and once the responses were submitted, participants could not edit their responses.

The online questionnaire was accessible to physiotherapists for a period of 5 weeks in June/July 2019, at which time all the data from the survey monkey platform was collected for analysis.

Every participants' responses for every survey question was saved in a folder marked response_1, response_2, etc. and stored for analysis.

The personal information collected from the physiotherapist was whether they have OMPG registration; their interest in orthopaedic/muscular/manual/manipulative therapy; the geographic region where they are practicing physiotherapy; whether they have any post-graduate qualifications; the length of time they have been qualified and practising as a physiotherapist; contact details (Table 3.2).

2.11 Data Analysis

The responses for each of the questions in the survey were recorded and documented for that particular respondent/physiotherapist. The responses were coded in an Excel workbook, and a number was allocated for every particular response to every particular question.

2.12 Statistical Analysis

Descriptive statistics (percentages) were applied to describe the demographics of the participants as well as the responses for each question. To asses for differences in the knowledge on screening, education, and exercise prescription of self-referring patients with IS among OMPG physiotherapists and non-OMPG physiotherapists, Chi-squared tests were

used to compare the proportions for every response to every question. The categorical variables were also analysed using Chi-squared tests to further compare the proportions (numbers and percentages) between the OMPG members and the non-OMPG members; the level of significance was set at 95%.

2.13 Ethical and Legal Considerations

Ethical approval was obtained from the Health Research Ethics Committee of Stellenbosch University (Appendix D). The project ID is 6769, and ethics reference number is S18/04/079. The study was conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

2.13.1 Informed Consent

The invitation letter (Appendix A) published in the newsletters contained an online link. When this link was followed the potential participants were taken to the information leaflet and consent form (Appendix B). In order for any member of the target population to gain access to the questionnaire and participate in the study the participant had to first read the information leaflet (Appendix B) and then the consent form (Appendix B), which was also included in the information leaflet.

The information leaflet and consent form (Appendix B) contained information on the research project, the identity of the principal investigator, and the contact details of the principal investigator and the Health Research Ethics Committee was given should participants have any further questions regarding the study and the questionnaire (Appendix C). The information leaflet also informed the potential participant what the research study was all about, how they would benefit by taking part in the study, whether there were any

risks involved in them participating in the study and whether there were any requirements involved in taking part in the study (Appendix B). It also indicated that participation was entirely voluntary and that the participant's identity would not be revealed. The document further also informed the study participants that the study had been approved by the Health Research Ethics Committee at Stellenbosch University and was conducted according to the ethical guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

The consent form was online, and the participants had to first tick acceptance and hereby provide individual consent to their participation in the study. Once the participants had provided consent they could proceed and gain access to the questionnaire.

2.13.2 CONFIDENTIALITY

The personal details of the participants and all the data collected during the study were handled confidentially. The identity of the participants in the study was never revealed during reporting or analysis of the data.

2.13.3 DISSEMINATION OF THE FINDINGS

The findings of the study may be published in scientific journals and presented at scientific meetings or conferences.

2.14 Conclusion

The chapter described the methodology followed to answer the research question discussed in chapter one. A survey design was followed, and information collected from the questionnaire responses. The categorical variables were analysed using Chi-squared tests to compare the proportions (numbers and percentages). The p-values were calculated for the results to

ascertain the level of significance and the difference between the results of the OMPG members and the non-members. The results obtained after following these methods is discussed in the following chapter (Chapter 3: Results).

Chapter 3

RESULTS

3.1 Introduction

The results will be presented in this chapter. This chapter will specifically describe the demographics and the summary responses to each of the questionnaire questions. Differences in the responses between the OMPG physiotherapists and the non-OMPG physiotherapists will also be illustrated.

3.2 Demographics of Study Participants

A total of two hundred and thirty-seven (237) participants completed the questionnaire. Nine (9) of the participants were students and three (3) participants indicated that they are not interested in the orthopaedic, muscular, manual or manipulative therapy/management of clients and was therefore excluded from the study. Another two (2) participants were excluded from the study as they completed the questionnaire after the cut-off date.

The two hundred and twenty-three (223) physiotherapists who participated and completed the questionnaire met all the requirements, and all their data was analysed. One hundred and sixteen (116) of the two hundred and twenty three (223) physiotherapists were registered with the OMPG, and one hundred and seven (107) were not members of this group but indicated that they are interested in the orthopaedic, muscular, manual or manipulative therapy/management of clients.

The study participants were spread across the 9 different provinces/regions of South Africa with Gauteng (34.5%) and the Western Cape (28.3%) having the most participants (see Table 3.1).

Table 3.1: Percentage of participants from the 9 different provinces in South Africa.

	Total Percentage (%)	OMPG Group (%)	Non-OMPG Group (%)
Western Cape	28.3	22.4	34.6
Gauteng	34.5	39.7	29
North West	4	3.4	4.7
Kwazulu-Natal	9	9.5	8.4
Free State	7.2	10.3	3.7
Limpopo	3.6	0.9	6.5
Eastern Cape	8.1	9.5	6.5
Mpumalanga	2.7	3.4	1.9
Northern Cape	2.7	0.9	4.7

The post-graduate experience of the study participants varied from 1-year post-graduate level to 20+ years of post-graduate experience. The most experienced participant had 35 years of post-graduate experience. There was a fairly equal proportionate distribution of years of experience between the participants. However, most of the OMPG participants had more than 10 years' experience compared to the non-OMPG members (see Table 3.2).

Table 3.2: Percentage of participants from the four different age groups.

	3 years and less (%)	4 – 9 years (%)	10 – 20 years (%)	Over 20 years (%)
Years post grad experience (n:223)	21.5	23.8	33.6	21.1
OMPG	11.2	20.7	42.2	25.9
Non-OMPG	32.7	27.1	24.3	15.9

The study participants had to indicate whether they have any post-graduate qualifications, and there was a significant difference between the OMPG and the non-OMPG participants. In the OMPG group, 67% of the members had post-graduate qualifications compared to only 37% in the non-OMPG group. In total, 53% of the study participants had post-graduate qualifications.

3.3 Survey Questions and Categories

When discussing the 'percentage of correct responses' within each item section below was the percentage of physiotherapists who selected the commonly accepted answer to each question posed against those who provided an attempted response.

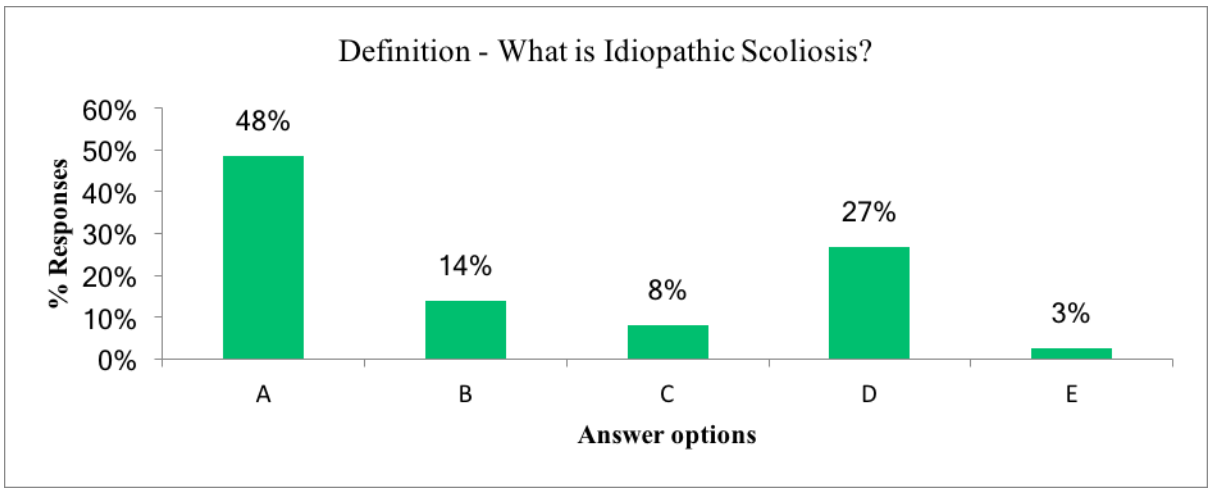
The 'percentage of correct responses' from the OMPG group members were also compared with the 'percentage of correct responses' from the non-OMPG group members to ascertain whether there was a difference between the groups.

The data will now be presented in the order of the questions:

3.3.1 Definition of Idiopathic Scoliosis

This question (What is idiopathic scoliosis?) assessed whether the physiotherapist was aware of scoliosis being a three-dimensional torsional deformity of the spine [21,2].

A total of 108 (48%) of the physiotherapists (n:223) answered the question correctly. 41% of the participants incorrectly thought that IS is a lateral curvature of the spine, and 8% of the participants suggested that it is a two-dimensional deformity of the spine (Figure 3.1).



A. **A three-dimensional torsional deformity of the spine and trunk that affects humans from infancy to after puberty.**

B. An abnormal lateral curvature of the vertebral column that affects humans from infancy to after puberty.

C. The most common two-dimensional deformation abnormality of the spine that has direct effects on the thoracic cage.

D. An unknown deformity of the vertebral column and trunk that results in lateral deviations of the spine in the frontal plane.

E. I'm not sure.

Figure 3.1 Participants responses: Definition of IS

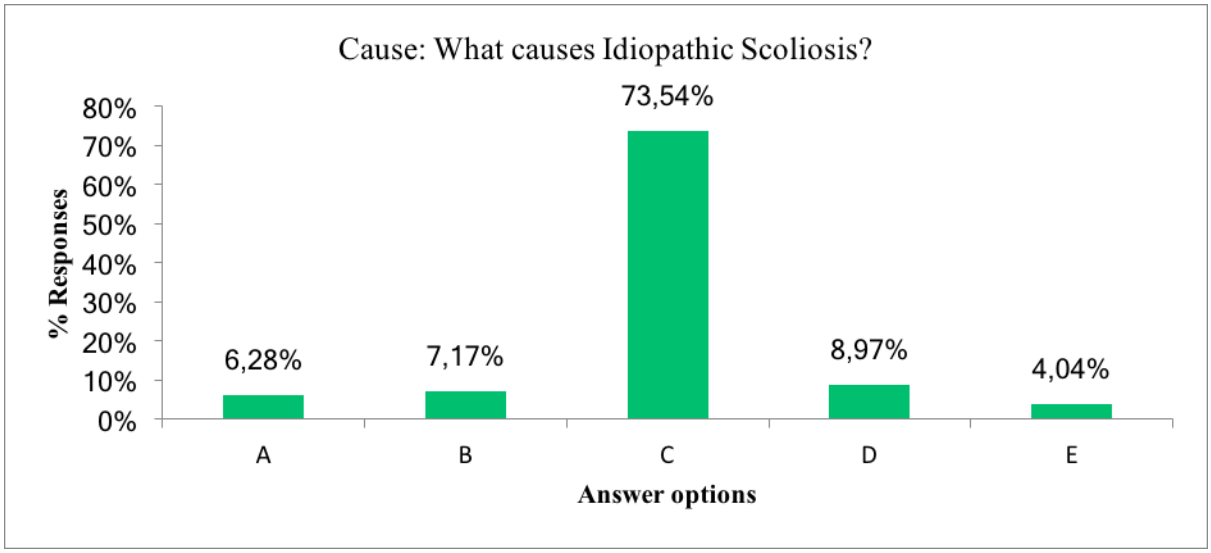
Table 3.3: Definition: Percentage correct responses between OMPG and Non OMPG Group

	Correct Response %	Incorrect Response %
OMPG group	56%	44%
Non OMPG group	40%	60%
Pearson Chi-Square (p-value)	0.01	

3.3.2 CAUSE OF IDIOPATHIC SCOLIOSIS

This question (What causes Idiopathic Scoliosis?) assessed whether the physiotherapist was aware of the aetiology of idiopathic scoliosis.

A total of 164 (73,5%) of the physiotherapists (n:223) answered the question correctly. Figure 3.2 indicates the various responses to this question.



A. It is caused by congenital, vertebral or rib malformation, and secondary to a variety of systemic or neuromuscular disorders.

B. Idiopathic scoliosis is an unknown disorder that can be attributed to a malformation of the spine during weeks three to six in utero.

C. **Idiopathic scoliosis is a structural scoliosis of the spine for which no specific cause can be established.**

D. Idiopathic scoliosis has a multifactorial etiology that consists of shortening of a lower limb, an increase in paraspinal muscle tone, or a malformation of the thoracic cage.

E. I'm not sure.

Figure 3.2 Participants responses: Cause of IS

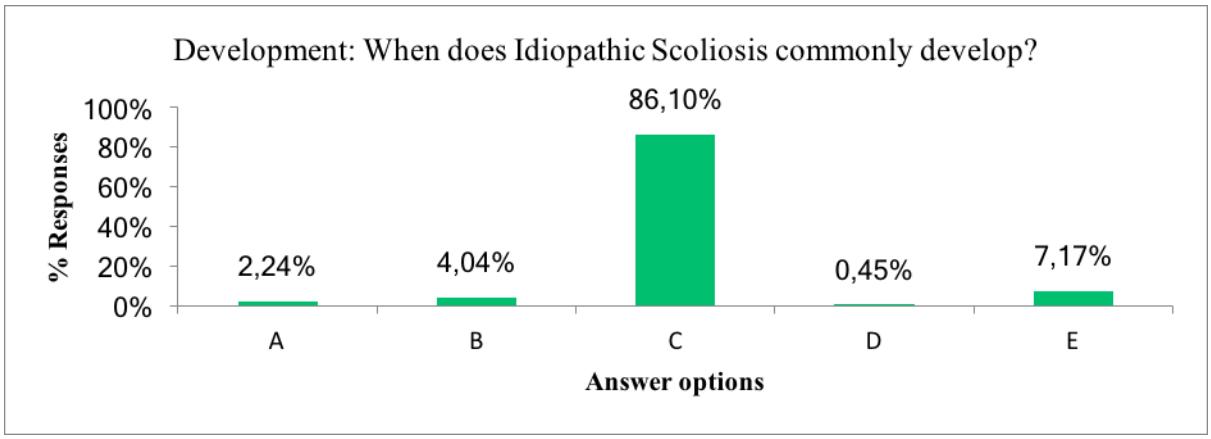
Table 3.4: Cause: Percentage correct responses between OMPG and non-OMPG Group

	Correct Response %	**Incorrect Response %**
OMPG group	75%	25%
Non-OMPG group	72%	28%
Pearson Chi-Square (p-value)	0.60	

3.3.3 Development of Idiopathic Scoliosis

This question (When does idiopathic scoliosis develop?) ascertained whether the physiotherapist was aware of when the developmental process occurs in idiopathic scoliosis. Out of all the questions, the physiotherapists performed the best with this question, and when given the options of either a period in adulthood, childhood/adolescence, in utero or as compensation to another disease, the participants correctly recognised that IS most commonly develops between a period in childhood and adolescence.

A total of 192 (86%) of the physiotherapists (n:223) answered the question correctly (Figure 3.3).



A. Idiopathic scoliosis develops in adulthood between the ranges of 35 years of age and older.

B. The development of idiopathic scoliosis is attributed to a malformation of the spine during week three to six in utero.

C. **Idiopathic scoliosis may develop at any time during childhood and adolescence.**

D. The development of idiopathic scoliosis is a compensatory disorder that is a result of a traumatic injury or disease.

E. I'm not sure.

Figure 3.3 Participants responses: Development of IS

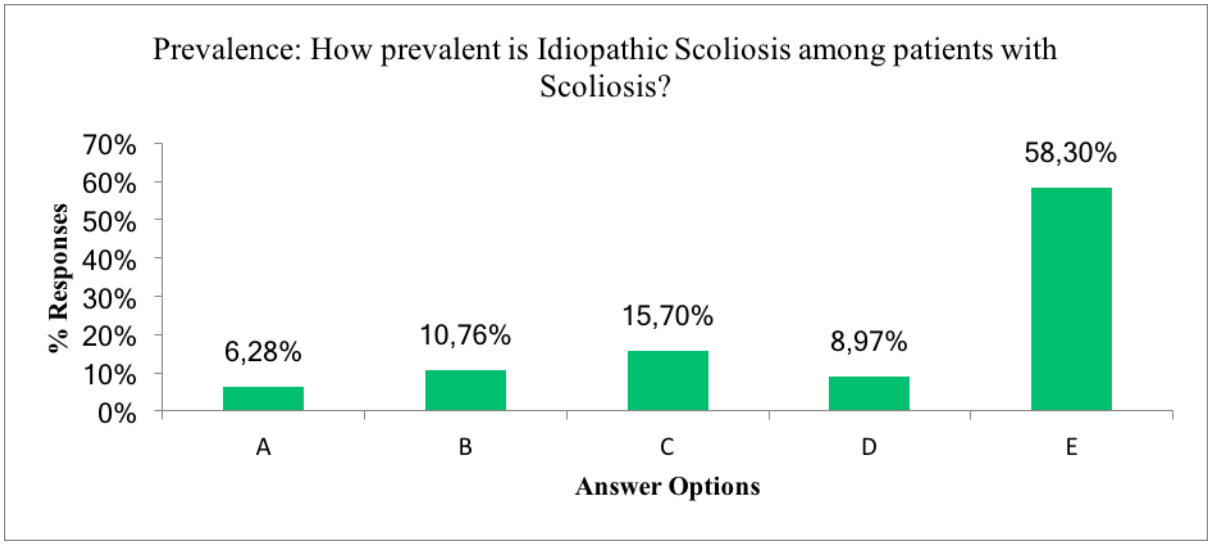
Table 3.5: Development: Percentage correct responses between OMPG and Non OMPG Group

	Correct Response %	Incorrect Response %
OMPG group	90%	10%
Non-OMPG group	81%	19%
Pearson Chi-Square (p-value)	0.04	

3.3.4 Prevalence of Idiopathic Scoliosis

This question (How prevalent is idiopathic scoliosis among patients with scoliosis?) assessed whether the physiotherapists were aware that 80% of all scoliosis cases were idiopathic [21,2]. This statistic is significant as only 20% of the cases diagnosed with scoliosis are a definite cause of the development of scoliosis identified by the physiotherapist/practitioner.

A total of 35 (15,7%) of the physiotherapists (n-223) that were included in the study answered the question correctly. The majority of the physiotherapists (58,3%) indicated that they were not sure and selected this answer for question 4 (figure 3.4).



A. Approximately 20% of cases are idiopathic scoliosis.

B. Approximately 60% of cases are idiopathic scoliosis.

C. **Approximately 80% of cases are idiopathic scoliosis.**

D. Approximately 40% of cases are idiopathic scoliosis.

E. I'm not sure.

Figure 3.4 Participants responses: Prevalence of IS

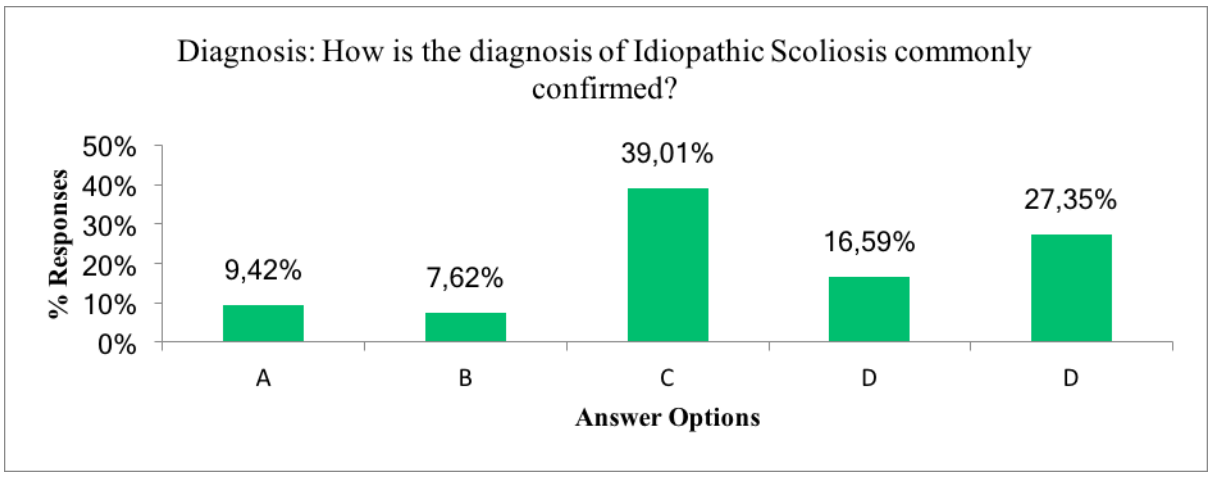
Table 3.6: Prevalence: Percentage correct responses between OMPG and Non OMPG Group

	Correct Response %	**Incorrect Response %**
OMPG group	15,5%	84.5%
Non OMPG group	15,9%	84.1%
Pearson Chi-Square (p-value)	0.93	

3.3.5 Diagnosis of Idiopathic Scoliosis

This question (How is the diagnosis of idiopathic scoliosis confirmed?) assessed whether the physiotherapists were aware of the process and requirements involved in diagnosing idiopathic scoliosis.

A total of 37 (16,5%) of the physiotherapists (n-223) that were included in the study answered this question correctly. Most of the physiotherapists (39%) participating in the study incorrectly indicated that the diagnosis is confirmed when 'The patient presents with asymmetrical iliac crest levels, 20° Cobb angle, and lateral curvature in the spine confirmed by X-rays'. Twenty-seven percent (27%) of the physiotherapists indicated that they are not sure and selected this answer for question 5. Figure 3.5 indicates the various responses to question 5.



A. A Cobb angle is 20° or greater confirmed by X-rays.

B. The patient presents with a rib hump and a lateral curvature in the spine confirmed by X-rays.

C. The patient presents with asymmetrical iliac crest levels, 20° Cobb angle, and lateral curvature in the spine confirmed by X-rays.

D. **The Cobb angle is ≥ 10°, and axial rotation can be recognised and confirmed by X-rays.**

E. I'm not sure.

Figure 3.5 Participants responses: Diagnosis of IS

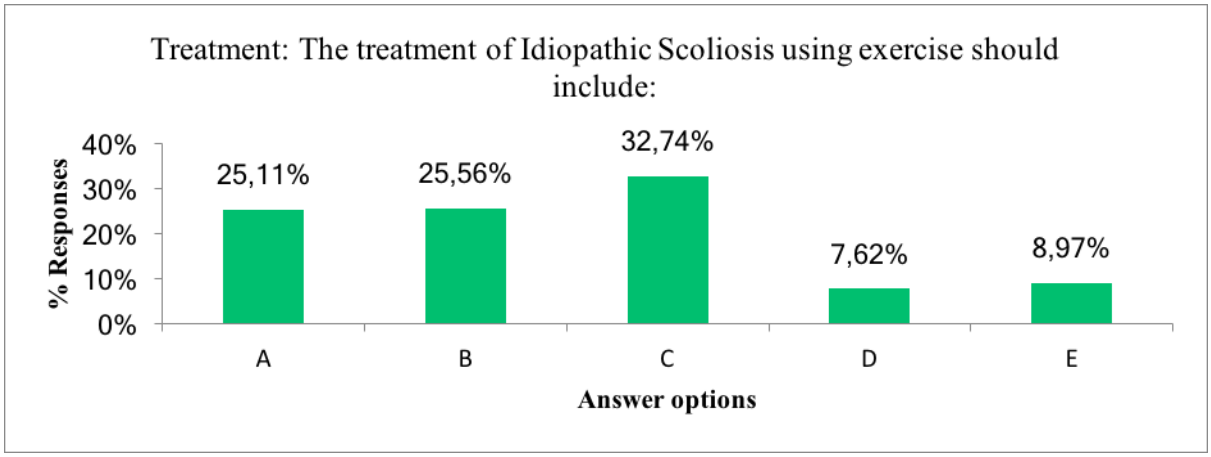
Table 3.7: Diagnosis: Percentage correct responses between OMPG and Non OMPG Group

	Correct Response %	**Incorrect Response %**
OMPG group	25%	75%
Non OMPG group	8%	92%
Pearson Chi-Square (p-value)	0.00	

3.3.6 TREATMENT OF IDIOPATHIC SCOLIOSIS

This question 'The treatment of idiopathic scoliosis using therapeutic exercise should include:' assessed whether the physiotherapists were aware of the best research-based treatment modalities for idiopathic scoliosis.

A total of 57 (26%) of the physiotherapists (n-223) that were included in the study answered this question correctly. Thirty-three percent (33%) of the physiotherapists thought that the treatment of IS using therapeutic exercise should include 'postural education, rotational breathing, and stretching have been shown to be the gold standard in research when considering treatment of idiopathic scoliosis.' A further 25% of the physiotherapists said that treatment should include 'focus on stretching the concave side of the primary curve and strengthening the convex side of the primary curve in the spine.' Figure 3.6 indicates the various responses to question 6.



A. focus on stretching the concave side of the primary curve and strengthening the convex side of the primary curve in the spine.

B. **the adaptation of old techniques and the addition of new forms that focus on auto-correction of the spine in three dimensions to prevent/limit progression.**

C. postural education, rotational breathing, and stretching have been shown to be the gold standard in research when considering the treatment of idiopathic scoliosis.

D. conservative care that includes bracing, simple observation, and core stabilisation exercises

E. I'm not sure.

Figure 3.6 Participants responses: Treatment of IS

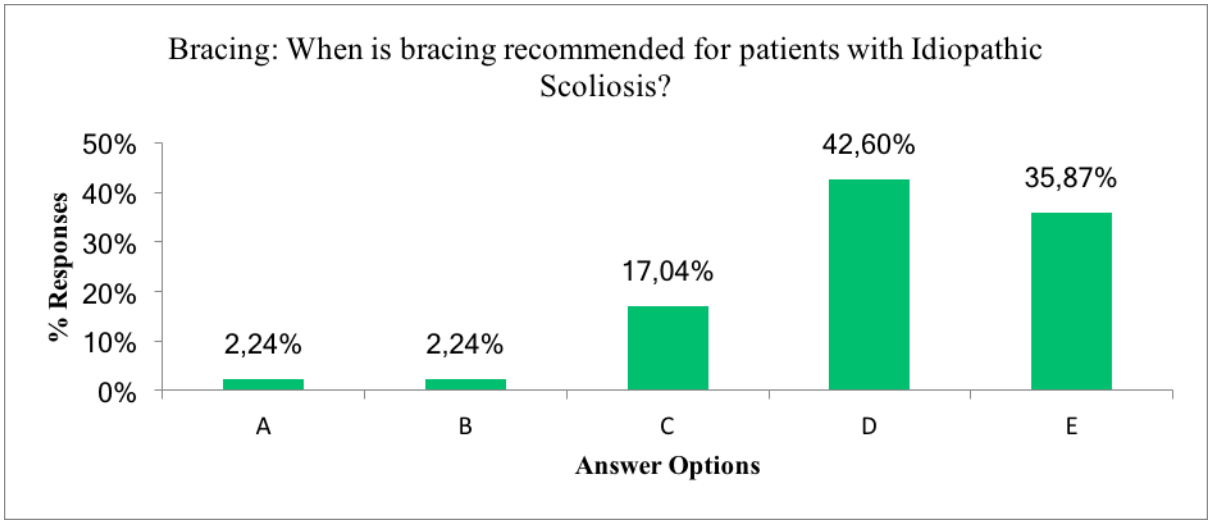
Table 3.8: Treatment: Percentage correct responses between OMPG and non-OMPG Group

	Correct Response %	**Incorrect Response %**
OMPG group	28%	72%
Non-OMPG group	23%	77%
Pearson Chi-Square (p-value)	0.38	

3.3.7 Bracing of Idiopathic Scoliosis

This question 'When is bracing recommended for patients with idiopathic scoliosis?' assessed whether the physiotherapists are aware that bracing should be recommended with a curve of 20° (±5) Cobb angle that has an elevated risk of progression.

A total of 95 (42.6%) of the physiotherapists (n-223) that were included in the study answered this question correctly. Seventeen (17%) of the physiotherapists indicated that patients who present with a primary curve that is 45° Cobb angle or higher should be recommended for scoliosis bracing. An astounding 35.8% of the physiotherapists indicated that they are not sure and selected this answer for question 7. Figure 3.7 indicates the various responses to question 7.



A. Patients that present with a primary curve between the ranges of 5°-10° Cobb angle should be recommended for scoliosis bracing.

B. Bracing is recommended for patients that have been diagnosed with functional scoliosis that is secondary to a leg length discrepancy of 6mm or greater.

C. Patients that present with a primary curve that is 45° Cobb angle or higher should be recommended for scoliosis bracing.

D. **Bracing is recommended for patients with a 20° (±5) Cobb angle that has an elevated risk of progressing.**

E. I'm not sure.

Figure 3.7 Participants responses: Bracing of IS

Table 3.9: Bracing: Percentage correct responses between OMPG and Non-OMPG Group

	Correct Response %	Incorrect Response %
OMPG group	49%	51%
Non-OMPG group	36%	64%
Pearson Chi-Square (p-value)	0.05	

3.3.8 Opinion-based: Beneficial and Harmful Activity in IS

The next two survey questions were aimed at identifying the physiotherapists' opinions on the types of physical activity that would be beneficial/harmful to a patient's scoliosis.

Ninety-eight (44%) of the 223 physiotherapists in the study believed that Pilates is the most beneficial activity followed by swimming (34%) (figure 3.8). In the OMPG group, 44 (38%) of the physiotherapists believed that Pilates is the most beneficial compared to 54 (51%) in the non-OMP group. In the OMPG group, 42 (36%) of the physiotherapists believed that swimming is the most beneficial compared to 31 (29%) in the non-OMPG group.

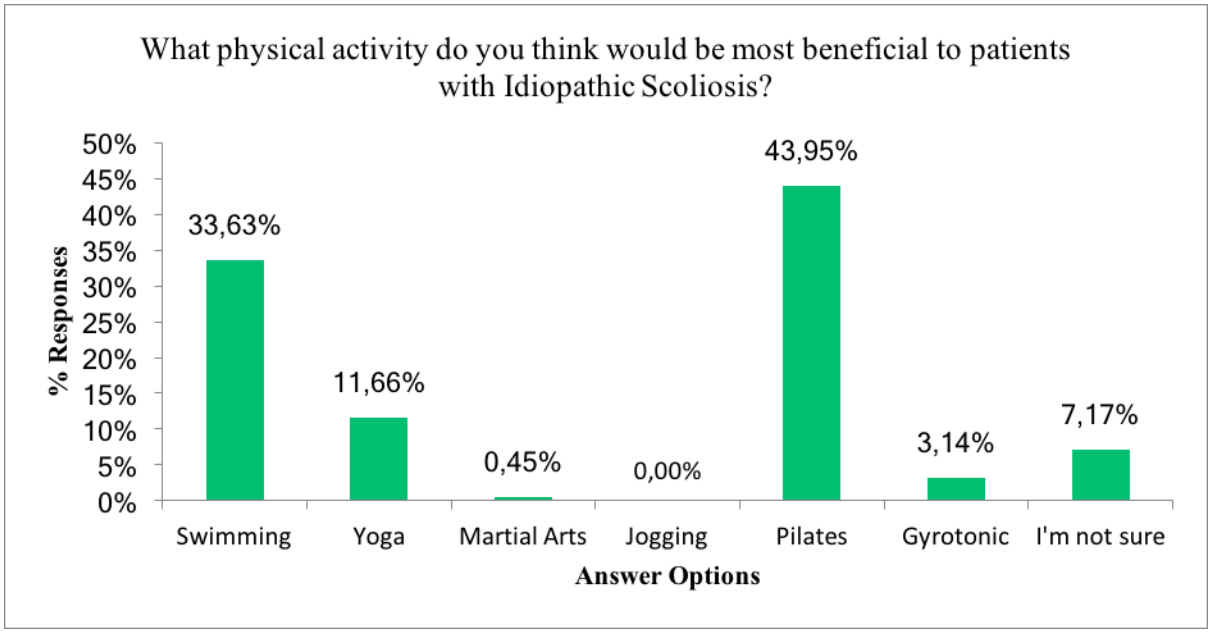


Figure 3.8 Participants responses: Opinion-Based beneficial activity in IS

Sixty-four (64) (28%) of the physiotherapists in the study believed that Gymnastics followed by martial arts (24%) is the most detrimental activity for IS patients. Sixty-two (62) (28%) of the physiotherapists indicated that they are not sure and chose this response for the question (figure 3.9). In the OMPG group, 32 (28%) of the physiotherapists believed that martial arts are the most detrimental activity compared to 35 (33%) in the non-OMPG group who believed that gymnastics is the most detrimental activity.

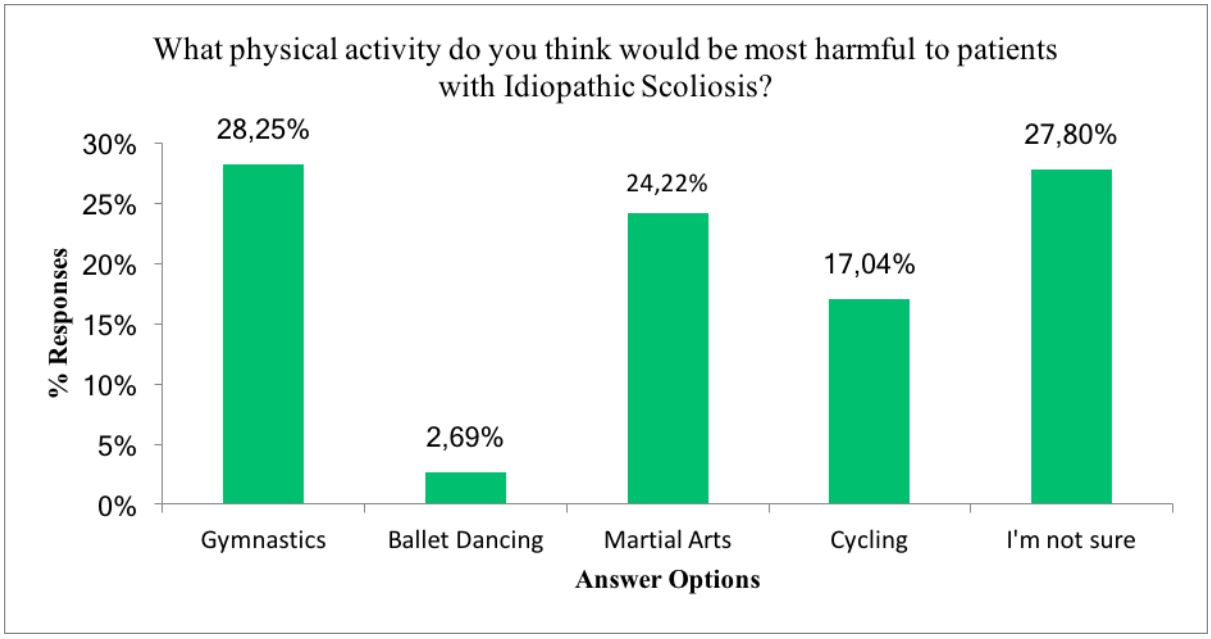
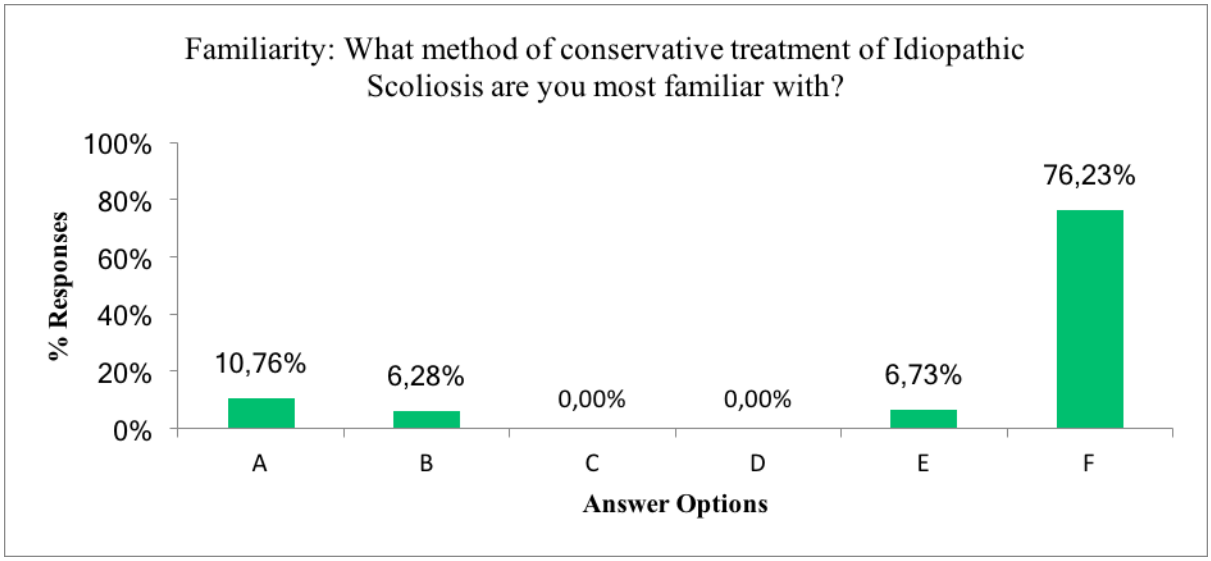


Figure 3.9 Participants responses: Opinion-Based harmful activity in IS

3.3.9 FAMILIARITY

This question 'what method of conservative treatment of idiopathic scoliosis are you most familiar with?' was aimed at identifying how familiar the physiotherapists' are with the different types of conservative treatment for IS. There are numerous physiotherapeutic scoliosis-specific exercise schools and methods with published evidence of efficacy in the conservative treatment of IS [21]; however, most of the physiotherapists in the study failed to recognise any of the methods. One hundred and seventy (170) (76%) of the physiotherapists indicated that they are not sure (figure 3.10). Seventy-eight percent (78%) of the physiotherapists in the OMPG group indicated that they are not sure compared to 74% in the non-OMPG group. The answers to this question also had an option where the participants could enter a treatment method that they are familiar with in case that method was not listed in the available options.



A. Lehnert-Schroth-Weiss

B. Klapp

C. Side-Shift

D. Dobosiewicz-Dobomed

E. Other - FITS

F. None

Figure 3.10 Participants responses: Familiarity of conservative treatment methods

3.3.10 Evidence Based Research and Conservative Management

This question 'According to evidence based research, what has been proven to be the most effective form of conservative management in idiopathic scoliosis?' was aimed at identifying what the participants' believe is the best form of conservative treatment according to the highest level of research studies. Bracing has proven to have the greatest number of papers at the highest level of evidence [21]. A total of 10 (4.5%) of the physiotherapists (n-223) that were included in the study selected 'Bracing' as their answer. A total of 120 (53.8%) of the physiotherapists (n-223) selected 'Physiotherapeutic scoliosis specific exercises' as their response. There was a very small difference between the OMPG and non-OMPG group pertaining to this question.

3.3.11 Adams Forward Bend Test and Scoliometer

This question 'Would you feel confident evaluating idiopathic scoliosis using the Adam's forward bending test and the Scoliometer?' aimed to assess the confidence of the physiotherapist when using the Adams forward bend test and the scoliometer in the assessment of an IS client. A total of 110 (49.3%) of the physiotherapists (n-223) that were included in the study indicated that they will not be confident and a further 72 (32.3%) indicated that they are unsure on how to use these assessment tools. A total of 41 (18.4%) of the physiotherapists indicated that they are confident using the Adams forward bend test and the scoliometer. The OMPG and the non-OMPG group had similar results with the OMPG group being slightly more confident with a total of 23 (19.8%) compared to the 18 (16.8%) of the non-OMPG group. 48.3% of the OMPG group indicated that they are not confident in the assessment compared to 50.5% of the non-OMPG group.

3.3.12 Educational Support to Client

This question 'Would you feel confident in providing educational support to a client presenting with idiopathic scoliosis?' aimed to assess the confidence of the physiotherapist in educating a client presenting with IS. A total of 106 (47.5%) of the physiotherapists (n-223) indicated that they will be confident in providing educational support to an IS client. 33.2% of the physiotherapists in the group indicated that they will not be confident and 19.3% indicated they are unsure. The OMPG and the non-OMPG group again had similar results with the OMPG group being slightly more confident with a total of 49.1% compared to the 45.8% of the non-OMPG group. 32.8% of the OMPG group indicated that they are not confident with providing educational support compared to the 33.6% of the non-OMPG group.

3.3.13 Confidence in Management of Client

This question 'Would you feel confident in the management of a client presenting with idiopathic scoliosis?' aimed to assess the confidence of the physiotherapist in the management of a client presenting with IS. A total of 104 (46.6%) of the physiotherapists (n-223) indicated that they will be confident in the management of an IS client. 53.4% of the physiotherapists in the group indicated that they will not be confident. The OMPG group was more confident in the management with 52.6% of the group indicating their confidence compared to 40.2% in the non-OMPG group. There was an insignificant difference ($p = 0.06$) between the OMPG members' knowledge and the non-members' knowledge.

3.3.14 Opinion on Physiotherapy based exercise intervention

The last question 'Do you feel the physiotherapy exercises intervention can be beneficial in the management of idiopathic scoliosis?' was aimed at identifying the physiotherapists' opinion on the effectiveness of physiotherapy directed exercise interventions in the management of IS. A total of 215 (96.4%) of the physiotherapists (n-223) indicated that physiotherapy exercise intervention can be beneficial in the management of IS. None of the participants indicated that it will not be beneficial and only 3.6% indicated that they are unsure.

3.4 Conclusion

The participants understood the development process involved in IS the best as this question had the most correct responses with 86%, followed by the cause of IS with 74% of the participating physiotherapy group providing the correct response. The participants had a poor understanding of the prevalence and diagnosis involved in IS, with only 16% and 17% of the participating physiotherapy group providing the correct responses followed by treatment with a 26% correct response rate. The study participants had a lower than 50% correct response

rate for the bracing involved in IS and more than 76% of the study population was not familiar with any of the conservative treatment methods recognised by SOSORT. Only 18.4% of the participating physiotherapy group indicated that they are confident using the Adams forward bend test and the scoliometer in evaluating scoliosis. The participating physiotherapy group had a lower than 50% confidence rate in the management and providing educational support to a IS client. The next chapter will discuss the data from this study and compare it to available literature.

Chapter 4

DISCUSSION

4.1 Introduction

The aim of this project was to assess the level of knowledge on Idiopathic scoliosis (IS) among registered practicing physiotherapists in South Africa (SA). The secondary objective was to determine if there was a difference in the level of knowledge between physiotherapists registered with the Orthopaedic Manipulative Physiotherapy Group (OMPG) and the physiotherapists that are not registered with this special interest group but are also interested in orthopaedic, muscular, manual or manipulative therapy. The last objective was to identify any knowledge gaps that should be addressed to improve the care of people with IS in South Africa (SA). In this chapter, the key findings are explored and interpreted to highlight the implications and relevance for practice and education.

4.2 Current Level of Knowledge on IS among Physiotherapists in SA

The study population comprised of 223 physiotherapists spread across the 9 different provinces of South Africa. Thirty-four percent (34%) of the study population was concentrated in Gauteng, which is the most populous province of South Africa, housing the largest city, Johannesburg, and its administrative capital, Pretoria. Most of the physiotherapists in the study population had between 10-20 years of post-graduate experience. However, the majority of the participants in the OMPG group had more than 10 years of experience compared to the non-OMPG group where most of the physiotherapists had less than 10 years of experience.

This was the first study to examine the basic current knowledge of IS among physiotherapists in South Africa. As mentioned the three previous surveys examined the physiotherapy students' knowledge of IS in Poland, USA, and the United Kingdom (UK), respectively [193-

195]. The survey used in the current study was based on a previously designed and tested 10-question survey which included the 2011 SOSORT guidelines [2,194]. The survey assessed the seven different aspects of IS and was divided into the following categories: definition, cause, development, prevalence, diagnosis, treatment, and bracing. An additional 5 questions were proposed by the review panel which assessed evidenced based conservative treatment and to ascertain the participants confidence with the assessment, management and education of IS patients.

4.2.1 The Prevalence and Diagnosis of IS

The questions dealing with the prevalence and diagnosis of IS had the worst 'correct' response rate and will be discussed first.

In SA, all physiotherapists registered with the Health Professions Council of South Africa (HPCSA) are considered first-line practitioners, working in an open and equal partnership with medical and other health care practitioners in the care of their patients. The definition of a first-line practitioner in SA, according to the HPCSA, is a person who can make an independent diagnosis and can treat such a condition, provided it falls within his / her scope of practice [208]. Should the condition fall outside of their scope of practice, this practitioner will refer on to another health care professional. This person is autonomous in professional decision-making. It is acknowledged that with "first line practitioner status" come accountability and legal responsibilities [208]. The physiotherapists practicing in South Africa, especially those that are in private clinics, are associated with helping people with musculoskeletal injuries and problems, and therefore, if one is experiencing back pain, spinal shift, or a muscle imbalance, the public will seek treatment, advice, and help from a physiotherapist. Having this first line practitioner status means that the physiotherapists practicing in South Africa need to be mindful of their area of expertise, referring patients to

the appropriate people when needed and providing appropriate treatment, rehabilitation specific exercises, and advice/education to the patient.

The first line practitioner status will mean that physiotherapists in South Africa will need to be confident and proficient with the screening of any potential IS patient. Screening is a highly contentious issue and detractors claim that it leads to increased costs, over referral, unnecessary radiation exposure, and treatment (primarily due to the relatively low rate of curves that actually require medical intervention) [162], although proponents argue that early detection is the key to successful management of idiopathic scoliosis [165-170].

In its 2011 guidelines, SOSORT recommended the screening of asymptomatic adolescents despite the doubts that have been raised [2]. SOSORT recommended school screening programmes using Adam's forward bend test and the scoliometer and advised that the tests should be done by clinicians specialised in spinal deformities [2]. In 2012, the South African government initiated the Integrated School Health Policy (ISHP), a policy initiative that is aimed at improving the health of school-going children and their respective communities (Department of Health [DOH] & Department of Basic Education [DOBE] 2012) [209]. In brief, the policy outlined the following assessments that will be done on all foundation phase learners [209]:

- Conduct vision, speech, and basic hearing screening.
- Measurement of height, weight, and Body Mass Index (BMI). Appropriate nutritional interventions must be planned accordingly.
- Check for fine and gross locomotor problems.
- Conduct oral health screening.

- Screen for a chronic illness or long-term health conditions - this includes both communicable diseases (such as TB and HIV/AIDS) as well as non-communicable diseases.
- Perform a basic mental health and/or psychosocial risk assessment.

No specific mention is made in the entire document as to the screening of children for spinal deformities or any other developmental disorders, including scoliosis. It is not clear whether screening for scoliosis is a service offered by the school health policy or whether a clinician specialised in spinal deformities carries out any of the examinations [209]. The policy, therefore, does not specifically state, recommend or advocate for the screening process of scoliosis [209]. The fact that the two questions in the survey that received the worst 'correct' response rate from the physiotherapy group dealt with the prevalence and diagnosis of IS increases the concern. These two topics are vital for a physiotherapist to understand and play a big part in the screening of clients, which has a detrimental impact on the prognosis of a client living with IS. SOSORT has indicated that 80% of all scoliosis cases are idiopathic [2,21] and that this is a diagnosis of exclusion which can only be applied with confidence when other causes of spinal deformity have been eliminated [32]. The fact that 80% of all scoliosis cases are idiopathic means that there is no known cause for scoliosis and first-line practitioners/physiotherapists in South Africa should account for this in their assessment of the client. This will directly impact the diagnosis made for the client, and therefore this question also had a very poor understanding and the second-worst 'correct' response rate with only 16.5% of the physiotherapy group selecting the widely accepted method of diagnosis recognised by SOSORT [2,21]. The physiotherapists participating in the study were therefore unable to recognise and diagnose an individual living with IS, which will mean that many IS patients in SA will be undiagnosed and will not receive the best care and

rehabilitation for their condition. Due to IS being a progressive disorder, early recognition, and identification of any individual at risk is extremely important in the rehabilitation of the client and can even prevent surgery [2,21]. Therefore, if the physiotherapist is aware of the diagnostic requirements involved with IS, potential patients at risk will be identified, rehabilitation started, and/or referred to the appropriate facility or health care professional. Despite the fact that physiotherapists are first-line practitioners in South Africa, the physiotherapists performed poorly in both of the above questions indicating concern that there is a lack of knowledge regarding spinal deformities, the screening process, and the correct diagnosis of these conditions which should be addressed.

4.2.2 The Cause and Development of IS

In only two of the questions in the survey did the participating physiotherapy group achieve a higher than 50% correct response rate. These two questions were regarding the cause and development of IS with the development category achieving the highest correct response rate of 86%. It is crucial for any health care professional dealing with musculoskeletal cases to firstly understand and know the difference between structural and non-structural/functional scoliosis and secondly to know that IS is structural scoliosis for which there is no specific cause [2,21]. All individuals diagnosed with structural scoliosis of the spine will have a permanent deformity of the spine compared to non-structural scoliosis, which can be corrected through appropriate treatment or rehabilitation exercise. The treatment methods and rehabilitation approach will, therefore, vary for the different kinds of scoliosis, and the condition can be exacerbated if the incorrect rehabilitation approach is followed, especially in the case of structural scoliosis like IS [2,21]. The health care professional also needs to be aware that IS can develop at any time during childhood and adolescence [2,21]. The cause and development need to be understood as this plays a vital role in the diagnosis, screening,

and management of IS. The rate of development in IS needs to be closely monitored during childhood and adolescence and especially during pubertal development as these stages have been recognised as having a high risk of curve progression [68,83]. Therefore, the cause and development process involved with IS was well understood by the participating physiotherapy group, which would assist with the understanding when gaining further knowledge into the other aspects involved in IS.

4.2.3 The Treatment of IS

In the clinical setting, treatment will follow assessment once the physiotherapist or health care professional has established the diagnosis of IS. The treatment of IS can involve numerous interventions depending on the stage and the risk of curve progression, which is multi-factorial and include gender, age at onset, Cobb angle, vertebral level of deformity, and remaining future growth potential [68]. Evidence-based clinical practice should dictate the rehabilitation approach/treatment procedures and is, by definition, the best integration between the knowledge offered by evidenced-based medicine, individual clinical expertise, and patients' preferences [92-94]. Consequently, different clinicians will treat a patient with the same clinical problem differently; the variation can be due to the patient's preferences or because of the specific expertise of the clinician. SOSORT supports the conservative treatment of all spinal deformities, and "Physiotherapeutic Scoliosis-specific Exercise (PSSE)" is one of these conservative therapeutic exercise treatment interventions [2,112,113]. These PSSE interventions have been recommended in the 2011 SOSORT Guidelines as the first step to treat IS to prevent/limit the progression of the deformity and bracing [126,127,149,151]. According to the PSSE principle each therapeutic exercise method should focus on auto-correction of the spine in three dimensions with the focus on restoration of spinal curvature [2,112]. In 2016 Berdishevsky et al. investigated the treatment approaches of

seven major schools operating under the SOSORT banner that focuses on the treatment of IS. They concluded that each of the seven schools promote a unique technique and unique exercises. However, the schools' overall goals are the same, as each method seeks to treat all aspects of the 3D scoliosis deformity and focus on auto-correction in three dimensions to prevent, limit progression [114]. Depending on the stage and presentation of the IS patient the treating therapist should adapt the scoliosis specific exercise techniques accordingly and use a combination of old and new forms [2,21,112]. These exercises must follow SOSORT consensus and patient education forms a crucial role and is part of the treatment protocol [113]. The above-mentioned research indicates that PSSE can have a positive influence on the quality of life of any individual diagnosed with IS, and therefore the physiotherapists in South Africa and worldwide can make a positive difference in the life of a client battling with IS. However, this question also received a very poor 'correct' response rate from the physiotherapists in the study group, with only 26% of the physiotherapists identifying that the standard feature of every scoliosis specific exercise should include three-dimensional self-correction [2,112,114]. The physiotherapists in the study group, therefore, had a very poor understanding and 'correct' response rate for the prevalence of IS (15.7%), followed by the diagnosis of IS (16.5%) and then the treatment involving therapeutic exercise (26%). All three of these questions assessed vital components of the role that a physiotherapist can play in the management of an IS patient and therefore should be addressed at university level and postgraduate level among the South African physiotherapy community. No other studies have been found in the literature that assessed health care professionals' knowledge on the prevalence, diagnosis and conservative treatment of IS in South Africa. The Physiotherapist can and should form an integral part in the rehabilitation and education of any client suffering from IS, and the sound knowledge and understanding of the IS condition are of the utmost importance to the success of the programme. Furthermore, due to the independence of the

first line practitioner status in South Africa, the physiotherapist should be very confident and knowledgeable on especially the above three questions dealing with the prevalence, diagnosis, and treatment of an IS patient.

4.2.4 The Definition and Bracing of IS

The next two questions dealing with the definition of IS and when bracing is recommended in IS received a better 'correct' response rate; however, the 'correct' response rate was still below 50% from the participating physiotherapy group. When managing an IS patient, all physiotherapists and other treating health care professionals need to understand and know what idiopathic scoliosis is. The fact that more than 50% of the group of physiotherapists incorrectly identified this illustrates that they will be on the back foot from day one when dealing with any IS patient. IS being a three-dimensional torsional deformity of the spine and not a lateral curvature of the spine, which 41% of the physiotherapy group incorrectly believed, will affect the management and especially the scoliosis specific exercise intervention undertaken by the physiotherapist. Bracing is another essential component in the conservative treatment of patients with IS [2,21]. Bracing has been confidently recommended in the treatment of adolescent idiopathic scoliosis due to numerous studies demonstrating the effectiveness through level I evidence [95-97,210-214]. Only 42.6% of the physiotherapists involved in the study correctly identified when bracing is recommended in IS patients, and 35.8% of the physiotherapists indicated that they are not sure. The three other studies that investigated the knowledge of physiotherapists regarding bracing in IS were done on physiotherapy students, and in all three of these studies, the physiotherapy students performed better than the physiotherapists in the current study [193-195]. This again identified a gap in the knowledge of when a referral should be made for brace treatment. to assist with bridging this gap the Health Professions Council of South Africa (HPCSA) and

the South African Society of Physiotherapy (SASP) can publish/advertise in their newsletters to health care professionals and the physiotherapy community on the respective braces that can be used in the management of IS. They can further educate the physiotherapists at undergraduate and post graduate levels on the indications when bracing is recommended and the uses and effectiveness of the different braces. The affordability of the braces could be a potential problem in South Africa, seeing that these braces are expensive, and not everyone in SA has access to medical insurance.

4.2.5 Opinion-based: Beneficial and Harmful Activity in IS

The opinion-based questions were constructed to identify the physiotherapists' opinion on sport activity that would be beneficial for IS patients and sport activity that would be harmful to IS patients. Research has recommended that sport should not be prescribed as a form of treatment for IS but that it should be recommended to patients that present with IS due to its psychological and social well-being benefits, as well as promoting neuromotor function and general activity in these individuals [6,156,201-206]. General sports activities however should not replace Physiotherapeutic Specific Exercises but can serve as an active counterpart in the holistic rehabilitation of an IS patient [207]. Pilates is a popular sport/therapeutic exercise intervention utilised by many physiotherapists in SA, and as a result, most of the physiotherapists involved in the study believed this to be the most beneficial activity. Pilates was followed by swimming, and these two activities contributed to the bulk of the responses. However, a study by Becker et al. identified that great care should be taken when recommending swimming to a scoliotic patient as a 6.9% incidence of scoliosis, 3.5-fold that in normal controls, has been reported in swimmers [206].

When questioned on harmful activities, there was more uncertainty among the physiotherapists as 27.8% of the physiotherapy group responded that they are not sure. Only

gymnastics had more responses followed by martial arts and cycling. Ballet dancing had the least responses (2.6%) and yet Warren et al. identified in a study conducted on young ballet dancers that their data suggest that a delay in menarche and prolonged intervals of amenorrhea that reflect prolonged hypoestrogenism may predispose ballet dancers to scoliosis and stress fractures [215]. SOSORT published in 2005 a Consensus Paper titled "Why do we treat adolescent idiopathic scoliosis? What do we want to obtain and to avoid for our patients? SOSORT 2005 Consensus paper" [39]. Esthetics, quality of life, and disability ranked in that order as the top three goals of treatment and physiotherapists incorporating PSSE, and specific sport activity can play a major part in helping IS patients achieve these goals [39,58].

4.2.6 FAMILIARITY

SOSORT has approved several conservative treatment methods and schools dealing with IS rehabilitation [114,116,117] and recommends that all PSSE should follow one of the schools that have shown the effectiveness of their approach with scientific studies [33,114,116,117,128,132,133,139,216,217]. These methods/schools have been around for many years and are continuously publishing new studies on the effectiveness of their techniques. Seven of the major schools and methods that have been approved by SOSORT include the Lyon approach from France [114], the Katharina Schroth approach from Germany [114], the Scientific Exercises Approach to Scoliosis from Italy [114,116], the Barcelona Scoliosis Physical Therapy School approach (BSPTS) from Spain [114], the DoboMed approach from Poland [114], the Side Shift approach from the United Kingdom [114,117] and the Functional Individual Therapy for Scoliosis [114] from Poland. Despite all these schools and research studies available only 23.8% of the physiotherapists involved in the study indicated that they are familiar with one of the schools/methods of conservative treatment. Therefore, an alarming 76.2% of the physiotherapists participating in the study

were not aware of any of the schools or recognised any treatment methods used for scoliosis rehabilitation, which leads to question what treatment protocol or exercise approach these physiotherapists would use when dealing with an IS patient. Most of the physiotherapists that responded to the current survey work in the private sector of South Africa, and as already mentioned, these physiotherapists will be first-line practitioners meaning the public does not require a referral to be seen by any of them. As discussed in the literature review there has been two studies that investigated the prevalence of IS in South Africa [161,163]. Both studies identified the prevalence of IS in SA and the authors of the most recent study [163] concluded that the incidence of scoliosis detected in their study group was much higher than what statistics for the United States and world incidence indicated and that socio-economic status seemingly has a strong influence on the prevalence of scoliosis [163]. This highlights the importance of creating awareness among the physiotherapy community and other health care professionals in SA on IS patient management and referral, providing avenues to further their knowledge through continuous professional development on the subject and the schools that are approved by SOSORT where they can seek further education and become specialists in the care of IS patients.

4.2.7 Additional Questions

The additional questions indicated that the participating physiotherapists believed that ‘PSSE’ has proven to be more effective than ‘bracing’. Despite bracing having the highest quality evidence (level 1), PSSE does have also have numerous studies proving the effectiveness of the exercises. Only 18.4% of the participating physiotherapists indicated that they are confident using the Adams forward bend test and scoliometer in the screening of clients and yet this is regarded as the main evaluation test in the clinical examination of a client. Less than 50% of the physiotherapy group involved in the study indicated that they will be

confident in providing educational support or managing an IS client. An overwhelming 96.4% of the physiotherapy group involved in the study believe that physiotherapy exercise intervention can be beneficial in the management of IS.

4.3 Current OMPG and non-OMPG Member Knowledge on IS

The Orthopaedic Manipulative Physiotherapy Group (OMPG) is a special interest group in South Africa that has a special interest in assessing and treating neuro-musculoskeletal, spinal, peripheral, and joint disorders. Physiotherapists that are members and registered with this group will therefore have a special interest in orthopaedics and musculoskeletal work and one would expect this group to be knowledgeable and the authority when it comes to IS patient care and management. This is also why one would be more likely to encounter an IS patient in their physiotherapy practice, clinic, or hospital seeking management, advice, and education. Therefore, this study also aimed to compare the OMPG and non-OMPG members' knowledge regarding IS.

In 85% of the questions, the OMPG group performed better than the non OMPG group. In 42% of the questions in the survey the OMPG group achieved a higher than 50% 'correct' response rate compared to the non-OMPG group who only managed to achieve a higher than 50% in 28% of the questions. There was a significant difference between the two groups in 57% of the questions in favor of the OMPG group. The responses and results in the OMP group were, therefore, better than the non-OMPG group, but the amount of years of post-graduate experience between the two groups could potentially have had an influence on the responses as the OMPG group had a much higher percentage of participants with more than 10 years of post-graduate experience.

However, the responses from the OMPG group was still too low for this group of physiotherapists to be recognised as the authority on the care and management of IS patients.

Particularly concerning was the fact that there was a smaller difference between the two groups when asked about the conservative treatment involved with IS. The OMPG group had a better 'correct' response rate of 5%; however, both groups performed poorly, not even achieving a higher than 30% 'correct' response rate. Due to the OMPG group being a special interest group concerned with Orthopaedic care and management, one would expect a higher than 28% 'correct' response rate. Furthermore, when questioned on the familiarity of the different methods of conservative treatment of IS the OMPG group was more unsure with 78% failing to recognise any method.

Short courses aimed at improving the knowledge of OMPG and other physiotherapists regarding IS can play an essential role in improving the care of IS patients in SA. Information and valid research studies aimed at improving IS knowledge can be sent out to members via newsletters.

4.4 Knowledge Gaps Identified and Future Research in SA

The results of the survey were particularly poor in relation to the prevalence of IS as well as the criteria involved in diagnosing an individual with IS. Due to the group not understanding these two aspects, they also performed poorly in identifying the conservative treatment involved in IS. These three areas form an integral part in the management of any patient dealing with IS and need to be addressed among the South African physiotherapy community that is working with orthopaedic clients and in particular, those dealing with scoliosis and IS patients. Definition and bracing performed slightly better however this was still below 50%, which is not good enough for any physiotherapists wanting to provide quality care to their patients/clients. The community and public of South Africa have direct access through self-referral to any physiotherapist, and therefore the physiotherapist will very often be the first

point of contact for the IS patient. This emphasises the importance of the physiotherapist being proficient in scoliosis management and care. Based on the results it appears that physiotherapists in South Africa are ill-equipped to provide this first point of care in relation to scoliosis, and they are unlikely to provide the standard of care, advice, onward referral, and exercise prescription that is required to manage such a progressive and time-sensitive condition. In Poland research has shown that physiotherapists who are educated in line with the 2011 SOSORT guidelines are much more familiar with scoliosis along with the treatment approaches available to this patient group [193].

Future research studies should be aimed at identifying:

- The prevalence and incidence of IS at the national level in SA. This study will assist in creating awareness among health care professionals, local universities, the SA government and the public on IS in SA. This can stimulate and potentially aide in government contribution to public health care, brace funding, and professional school screening services for IS patients.
- The content of the curriculum taught at undergraduate level to physiotherapy students at any of the universities in South Africa, which would also help build the knowledge base and create interest among the South African physiotherapy community.
- Whether there are any appropriate referral strategies for scoliosis patients and health care professionals dealing with this condition.
- Whether there are differences between the type of management and referral involved in the private sector compared to the government.

Chapter 5

CONCLUSION

5.1 Introduction

The main objective of this study was to assess the basic level of knowledge on Idiopathic scoliosis (IS) among registered practicing physiotherapists that are interested in the orthopaedic, muscular, manual or manipulative therapy of clients in South Africa (SA). Due to their interest, these physiotherapists would be most likely to encounter IS in their practice. The physiotherapy group had a poor understanding of the prevalence, diagnosis, and treatment involved in IS affected clients as well as a lack of knowledge regarding the methods of conservative treatment and scoliosis schools available worldwide with more than 76% of the group not being aware of any of the schools or recognised any treatment methods used for scoliosis rehabilitation. More than 50% of the group was unable to recognise and define IS or determine when bracing is recommended for IS patients.

Our findings showed that one third (33.6%) of the physiotherapists participating in the study could answer more than 50% of the questions correctly, and 16.5% could answer 70% of the questions correctly in relation to the widely accepted guidelines on IS management. The physiotherapists did perform better than the physiotherapy students in the UK with the Blake et al. study where only 7% of the physiotherapy students answered more than 50% of the questions correctly [195] and the Drake et al. study where 8% of the USA physiotherapy students answered 70% of the questions correctly [194]. Compared to the study conducted in Poland by Ciazynski et al., the physiotherapists in the current study performed worse in all categories [193]. The study was, however, done on a small group (n-37) of students attending the 3rd year of the first-degree physiotherapy. The students also had credits in kinesiotherapy, including methods of conservative treatment of IS [193]. Even though the students achieved

far superior results in the Ciazynski et al. study, the authors still concluded that the average level of knowledge of idiopathic scoliosis among the students of physiotherapy is unsatisfactory, despite the education programme including the SOSORT guidelines [193]. All the above studies [193-195], including the current study conducted in SA, identified a lack of knowledge regarding the basic knowledge of IS. The current study was however performed on post graduated physiotherapists and therefore a direct comparison with physiotherapy students and especially physiotherapy students that had already covered conservative treatment methods for scoliosis in their syllabus [193] should be considered and put into perspective.

5.2 Limitations of the Study

The main limitations of this study were the number of physiotherapists (n:223) who agreed to participate and passed the inclusion criteria. This is only a segment of all the physiotherapists registered with OMPG and the HPCSA. Many of the physiotherapists that participated in the study work in private practice, and their experience would be different from physiotherapists working in the government sectors. The information in the study was self-reported, and therefore there could have been biased, which could have impacted the outcomes/findings. The survey conducted provides an overview but not an in-depth understanding of knowledge. It is very complex to assess knowledge honestly, and this can potentially be improved with face to face discussions and interviews, course examination, or testing.

The physiotherapists who agreed to participate may be those who have a greater interest in improving individual practice and knowledge, and they may be more knowledgeable about musculoskeletal conditions. Due to the fact that the questionnaires was sent to the participants, meant that they had time to search for answers and read up on IS.

5.3 Value of the Study

This study presented an overview on the knowledge of IS among a group (n=223) of physiotherapists interested in the orthopaedic, muscular, manual or manipulative therapy in SA. The study hopes to encourage further research into idiopathic scoliosis and the knowledge gaps identified. The management and education of an idiopathic scoliosis patient needs to be vigilantly tracked and directed by the managing physiotherapist. Each idiopathic scoliosis patient may have a different presentation and requirements and it's up to the managing physiotherapist to recognise these differences and adjust his management approach according to the most up to date research/literature on the subject to ensure the best possible outcome for the client. This study hopes to create awareness among the physiotherapy group involved in the orthopaedic, muscular, manual and manipulative care of clients of all age groups about idiopathic scoliosis and its complex presentation and management.

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APPENDIX A:

INVITATION LETTER

Dear Physiotherapist,

I would like to invite you to participate in a research study on the Knowledge of Idiopathic Scoliosis in South Africa.

All you need to do is complete an online questionnaire which would not take you longer than 10 minutes to complete.

The study has been approved by the Health Research Ethics Committee at Stellenbosch University and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

The goal of this project is to inform, educate and create awareness on the role that a physiotherapist can play in improving the quality of life in patients with Idiopathic Scoliosis.

By taking part you will contribute in identifying whether there is a need for the development of clinical guidelines for clinical decision making in dealing with IS patients in South Africa.

Your identity will not be revealed and there are no risks involved.

By completing the questionnaire, you will also stand a chance of winning R1500 in a lucky draw competition.

If you are happy to proceed please click on the link: //www.surveymonkey.com/r/scolres to complete the information leaflet/consent form, questionnaire and lucky draw details.

If you need any further information please do not hesitate to contact me.

Yours sincerely,

Abraham (Braam) du Toit

Principle investigator

Email: braam@physiotrainsmart.com

APPENDIX B:

INFORMATION AND CONSENT FORM

Principal Investigator: A.C.Braam Du Toit

Address: University of Stellenbosch, Department of Physiotherapy

Contact Details: braam@physiotrainsmart.com

Dear Physiotherapist,

My name is Abraham (Braam) du Toit and I am a Physiotherapist.

I would like to invite you to participate in a research project that aims to investigate the knowledge of Idiopathic Scoliosis (IS) in South Africa.

Please take some time to read the information presented here, which will explain the details of this project. Please ask any questions about any part of this project that you do not fully understand. Your participation is entirely voluntarily and you are free to decline to participate.

The study has been approved by the Health Research Ethics Committee at Stellenbosch University and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

Practicing physiotherapists registered with the Health Professions Council of South Africa (HPCSA) and Orthopaedic Manipulative Physiotherapy Group (OMPTG) in South Africa will be asked to answer an online questionnaire on survey monkey regarding the knowledge of idiopathic scoliosis in South Africa.

The study aims to identify whether there are any gaps in the knowledge of IS among the practicing physiotherapists registered with the HPCSA and the OMPTG of South Africa.

The goal is to inform, educate and create awareness on the role that a physiotherapist can play in improving the quality of life in patients with IS.

Will you benefit from taking part in this research?

By taking part you will contribute in identifying the knowledge base of South African Physiotherapists regarding IS patients.

The study will also ascertain if there is a need for the development of clinical guidelines for clinical decision making in dealing with IS patients in South Africa.

The information will be presented in the research study and you will benefit by enhancing your knowledge on the subject.

By completing a questionnaire, you will stand a chance of winning R 1500 in a lucky draw competition.

Are there any risks involved in taking part in this research?

There are no risks involved in you taking part.

Your identity will not be revealed in the study.

Are there any requirements involved in taking part in this research?

You have to be registered with the HPCSA and actively practicing physiotherapy in South Africa.

By agreeing to participate in this study, you declare that:

- I have read the information leaflet and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurized to take part.

If you are willing to participate, please continue to access the questionnaire. The questionnaire will not take more than 10 minutes of your time.

Yours sincerely,

Abraham (Braam) du Toit

Principle investigator

APPENDIX C:

QUESTIONNAIRE USED IN STUDY

The knowledge on Idiopathic Scoliosis in South Africa Questionaire

Are you a member of the Orthopaedic Manipulative Physiotherapy Group?

Yes No

Are you interested in either Orthopaedic, Muscular, Manual or Manipulative therapy?

Yes No

In what Province of South Africa do you practice Physiotherapy?

In what year did you obtain your primary Physiotherapy qualification?

Have you obtained any Post Graduate qualifications?

How many years have you been practicing as a Physiotherapist?

Choose the best answer for the following questions…

1. What is idiopathic scoliosis?
    A. A three-dimensional torsional deformity of the spine and trunk that affects humans from infancy to after puberty.
    B. An abnormal lateral curvature of the vertebral column that affects humans from infancy to after puberty.
    C. The most common two-dimensional deformation abnormality of the spine that has direct effects on the thoracic cage.
    D. An unknown deformity of the vertebral column and trunk that results in lateral deviations of the spine in the frontal plane.
    E. I'm not sure.

2. What causes idiopathic scoliosis?
    A. It is caused by congenital, vertebral or rib malformation, and secondary to a variety of systemic or neuromuscular disorders.
    B. Idiopathic scoliosis is an unknown disorder that can be attributed to a malformation of the spine during week three to six in utero.
    C. Idiopathic scoliosis is a structural scoliosis of the spine for which no specific cause can be established.

D. Idiopathic scoliosis has a multifactorial etiology that consists of shortening of a lower limb, increase in paraspinal muscle tone, or a malformation of the thoracic cage.

E. I'm not sure.

3. When does idiopathic scoliosis commonly develop?

A. Idiopathic scoliosis develops in adulthood between the ranges of 35 years of age and older.

B. Development of idiopathic scoliosis is attributed to a malformation of the spine during week three to six in utero. (Wiki Causes)

C. Idiopathic scoliosis may develop at any time during childhood and adolescence.

D. Development of idiopathic scoliosis is a compensatory disorder that is a result of a traumatic injury or disease.

E. I'm not sure.

4. How prevalent is idiopathic scoliosis among patients with scoliosis?

A. Approximately 20% of cases are idiopathic scoliosis.

B. Approximately 60% of cases are idiopathic scoliosis.

C. Approximately 80% of cases are idiopathic scoliosis.

D. Approximately 40% of cases are idiopathic scoliosis.

E. I'm not sure.

5. How is the diagnosis of idiopathic scoliosis commonly confirmed?

A. A Cobb angle is 20° or greater confirmed by X-rays.

B. The patient presents with a rib hump and a lateral curvature in the spine confirmed by X-rays.
C. The patient presents with asymmetrical iliac crest levels, 20° Cobb angle, and lateral curvature in the spine confirmed by X-rays.
D. The Cobb angle is ≥ 10° and axial rotation can be recognised and confirmed by X-rays.
E. I'm not sure.

6. The treatment of idiopathic scoliosis using therapeutic exercise should include:
   A. focus on stretching the concave side of the primary curve and strengthening the convex side of the primary curve in the spine.
   B. the adaptation of old techniques and the addition of new forms that focus on auto-correction of the spine in three dimensions to prevent/limit progression.
   C. postural education, rotational breathing, and stretching have been shown to be the gold standard in research when considering treatment of idiopathic scoliosis.
   D. conservative care that includes bracing, simple observation, and core stabilization exercises
   E. I'm not sure.

7. When is bracing recommended for patients with idiopathic scoliosis?
   A. Patients that present with a primary curve between the ranges of 5°-10° Cobb angle should be recommended for scoliosis bracing.
   B. Bracing is recommended for patients that have been diagnosed with functional scoliosis that is secondary to a leg length discrepancy of 6mm or greater.

C. Patients that present with a primary curve that is 45° Cobb angle or higher should be recommended for scoliosis bracing.
D. Bracing is recommended for patients with a 20° (±5) Cobb angle that have an elevated risk of progressing.
E. I'm not sure.

8. What physical activity do you think would be most beneficial to patients with idiopathic scoliosis?
    A. Swimming
    B. Yoga
    C. Martial Arts
    D. Jogging
    E. Pilates
    F. Gyrotonic
    G. I'm not sure

9. What physical activity do you think would be most harmful to patients with idiopathic scoliosis?
    A. Gymnastics
    B. Ballet Dancing
    C. Martial Arts
    D. Cycling
    E. I'm not sure

10. What method of conservative treatment of idiopathic scoliosis are you most familiar with?

    A. Lehnert-Schroth-Weiss
    B. Klapp
    C. Side-Shift
    D. Dobosiewicz-Dobomed
    E. Other-FITS
    F. None

Comments: _____

_____

11. According to evidence based research, what has been proven to be the most effective form of conservative management in idiopathic scoliosis?

    A. Nothing.
    B. Observation.
    C. Physiotherapeutic Scoliosis specific exercises.
    D. Bracing.
    E. Special inpatient rehabilitation.
    F. I'm not sure.
    G. Participating in sport

Comments: _____

_____

12. Would you feel confident evaluating idiopathic scoliosis using the Adam's forward bending test and the Scoliometer?

a. Yes

b. No

c. Unsure

13. Would you feel confident in providing educational support to a client presenting with idiopathic scoliosis?

a. Yes

b. No

c. Unsure

14. Would you feel confident in the management of a client with idiopathic scoliosis?

a. Yes

b. No

c. Unsure

15. Do you feel that physiotherapy exercise intervention can be beneficial in the management of idiopathic scoliosis?

a. Yes

b. No

c. Unsure

APPENDIX D:

ETHICAL APPROVAL FORM

UNIVERSITEIT STELLENBOSCH UNIVERSITY

Health Research Ethics Committee (HREC)

Approval Notice

New Application

18/09/2018

Project ID :6769

HREC Reference # S18/04/079

Title: The knowledge of Idiopathic Scoliosis among Practicing Physiotherapists in South Africa: An exploratory study

Dear Mr Abraham Du Toit

The **New Application** received on 20/07/2018 20:58 was reviewed by members of **Health Research Ethics Committee** via **expedited** review procedures on 18/09/2018 and was approved.

Please note the following information about your approved research protocol:

Protocol Approval Period: **18 September 2018 - 17 September 2019**.

Please remember to use your project ID (6769) and HREC reference number (S18/04/079) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review

Translation of the informed consent document(s) to the language(s) applicable to your study participants should now be submitted to the HREC.

Please note you can submit your progress report through the online ethics application process, available at: Links Application Form Direct Link and the application should be submitted to the HREC before the year has expired. Please see *Forms and Instructions* on our HREC website (www.sun.ac.za/healthresearchethics) for guidance on how to submit a progress report.

The HREC will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility, permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Please consult the Western Cape Government website for access to the online Health Research Approval Process, see: https://www.westerncape.gov.za/general-publication/health-research-approval-process. Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.

For standard HREC forms and instructions, please visit: Forms and Instructions on our HREC website https://applyethics.sun.ac.za/ProjectView/Index/6769

If you have any questions or need further assistance, please contact the HREC office at 021 938 9677.

Yours sincerely,

Mrs. Ashleen Fortuin

Health Research Ethics Committee 1 (HREC1)

National Health Research Ethics Council (NHREC) Registration Number:

REC-130406-012 (HREC1)•REC-230206-010 (HREC2)

Federal Wide Assurance Number: 00001372

Page 1 of 2

APPENDIX E:

INITIAL QUESTIONNAIRE

The knowledge on Idiopathic Scoliosis in South Africa Questionnaire

Are you a member of the Orthopaedic Manipulative Physiotherapy Group?

Yes No

Are you interested in either Orthopaedic, Muscular, Manual or Manipulative therapy?

Yes No

In what Province of South Africa do you practice Physiotherapy?

In what year did you obtain your primary Physiotherapy qualification?

Have you obtained any Post Graduate qualifications?

How many years have you been practicing as a Physiotherapist?

***The answers to the questionnaire provided to the panel is in bold and capital and this will be removed along with the references, brackets, etc. to prevent bias in the main study.**

This is included in the questionnaire to the panel to assist with understanding the goal of the questions/answers in the study.

Choose the best answer for the following questions…

1. What is idiopathic scoliosis? (DEFINING)
    A. **A THREE-DIMENSIONAL TORSIONAL DEFORMITY OF THE SPINE AND TRUNK THAT AFFECTS HUMANS FROM INFANCY TO AFTER PUBERTY. (SOSORT PG 3)**
    B. An abnormal lateral curvature of the vertebral column that affects humans from infancy to after puberty. (Otman pg 1)
    C. The most common two-dimensional deformation abnormality of the spine that has direct effects on the thoracic cage. (Tsiligiannis pg 1)
    D. An unknown deformity of the vertebral column and trunk that results in lateral deviations of the spine in the frontal plane.
    E. I'm not sure.

Comments: _____

_____

2. What causes idiopathic scoliosis? (CAUSE)
    A. It is caused by congenital, vertebral or rib malformation, and secondary to a variety of systemic or neuromuscular disorders. (Tsiligiannis pg 1)
    B. Idiopathic scoliosis is an unknown disorder that can be attributed to a malformation of the spine during week three to six in utero. (Wiki Causes)
    C. **IDIOPATHIC SCOLIOSIS IS A STRUCTURAL SCOLIOSIS FOR WHICH NO SPECIFIC CAUSE CAN BE ESTABLISHED. (TSILIGIANNIS PG 1)**
    D. Idiopathic scoliosis has a multifactorial etiology that consists of shortening of a lower limb, increase in paraspinal muscle tone, or a malformation of the thoracic cage. (SOSORT pg 4)
    E. I'm not sure.

Comments: _____

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3. When does idiopathic scoliosis commonly develop? (DEVELOPMENT)
    A. Idiopathic scoliosis develops in adulthood between the ranges of 35 years of age and older.
    B. Development of idiopathic scoliosis is attributed to a malformation of the spine during week three to six in utero. (Wiki Causes)
    C. **IDIOPATHIC SCOLIOSIS MAY DEVELOP AT ANY TIME DURING CHILDHOOD AND ADOLESCENCE. (SOSORT PG 5)**

D. Development of idiopathic scoliosis is a compensatory disorder that is a result from a traumatic injury or disease.

E. I'm not sure.

Comments: _____

_____

4. How prevalent is idiopathic scoliosis among patients with scoliosis? (PREVALENCE)

   A. Approximately 20% of cases are idiopathic scoliosis.

   B. Approximately 60% of cases are idiopathic scoliosis.

   C. **APPROXIMATELY 80% OF CASES ARE IDIOPATHIC SCOLIOSIS**. (**SOSORT PG 4)**

   D. Approximately 40% of cases are idiopathic scoliosis.

   E. I'm not sure.

Comments: _____

_____

5. How is the diagnosis of idiopathic scoliosis commonly confirmed? (DIAGNOSIS)

   A. A Cobb angle is 20° or greater.

   B. The patient presents with a rib hump and a lateral curvature in the spine.

   C. The patient presents with asymmetrical iliac crest levels, 20° Cobb angle, and lateral curvature in the spine.

   D. **The COBB ANGLE IS ≥ 10° AND AXIAL ROTATION CAN BE RECOGNISED. (SOSORT PG 4)**

E. I'm not sure.

Comments: _____

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6. The treatment of idiopathic scoliosis using therapeutic exercise should include: (TREATMENT)

   A. focus on stretching the concave side of the primary curve and strengthening the convex side of the primary curve.

   B. **THE ADAPTATION OF OLD TECHNIQUES AND THE ADDITION OF NEW FORMS THAT FOCUS ON AUTO-CORRECTON IN THREE DIMENSIONS TO PREVENT / LIMIT PROGRESSION. (WEISS PG 1, SOSORT PG 20)**

   C. postural education, rotational breathing, and stretching have been shown to be the gold standard in research when considering treatment of idiopathic scoliosis.

   D. conservative care that includes bracing, simple observation, and core stabilization exercises

   E. I'm not sure.

Comments: _____

_____

7. When is bracing recommended for patients with idiopathic scoliosis? (BRACING)

A. Patients that present with a primary curve between the ranges of 5°-10° Cobb angle should be recommended for scoliosis bracing.
B. Bracing is recommended for patients that have been diagnosed with functional scoliosis that is secondary to a leg length discrepancy of 6mm or greater.
C. Patients that present with a primary curve that is 45° Cobb angle or higher should be recommended for scoliosis bracing. (Otman pg 2)
D. **BRACING IS RECOMMENDED FOR PATIENTS WITH A 20° (±5) COBB ANGLE THAT HAVE AN ELEVATED RISK OF PROGRESSING. (SOSORT PG 18)**
E. I'm not sure.

Comments: _____

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8. What physical activity do you think would be most beneficial to patients with idiopathic scoliosis? (PHYSICAL ACTIVITY AND ITS INFLUENCE) (SOSORT PG 23, CIAZYNSKI PG 2)
    A. Swimming
    B. Yoga
    C. Martial Arts
    D. Jogging
    E. Other

Comments: _____

_____

9. What physical activity do you think would be most harmful to patients with idiopathic scoliosis? (PHYSICAL ACTIVITY AND ITS INFLUENCE) (SOSORT PG 23, CIAZYNSKI PG 2)
    A. Gymnastics
    B. Ballet Dancing
    C. Martial Arts
    D. Cycling
    E. None
    F. Other

Comments: _____

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10. What method of conservative treatment of idiopathic scoliosis are you most familiar with? (FAMILARITY, CIAZYNSKI PG 2)
    A. Lehnert-Schroth-Weiss
    B. Klapp
    C. Majoch
    D. Dobosiewicz
    E. None
    F. Other

Comments: _____

_____

***For questions 8-10 there are no right or wrong answers. Questions were generated in order to compare the general thought process of the physiotherapists.**

Additional comments and suggestions:
