

# Screening And Therapy Of Sports On Scoliosis At Secondary Schools In Makassar Indonesia

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## Screening And Therapy Of Sports On Scoliosis At Secondary Schools In Makassar Indonesia

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### Abstract

*This study aims to identify the presence (prevalence) of scoliosis among high school students and to assess the effect of Theraline physical exercise therapy on cases of scoliosis. The method used is through scoliosis screening by using a sample of 29 students in SMA Makassar. Data collection techniques used interviews, questionnaires regarding healthy living behaviors, daily physical activity and specifically the risk factors for scoliosis related to age, gender, healthy lifestyle, sitting/studying position, and the habit of carrying a side bag. Then, an examination of spinal alignment/scoliosis with DiersPedoformetric. After examination, 5 samples were selected which identified scoliosis spine alignment disorders. Selected samples received theraline therapy for 10 days. After theraline therapy, a post-exercise examination was conducted, and compared the changes in spinal alignment parameters that occurred before and after exercise. The results showed that of the 29 research samples, there were 13 people (44.8%) who had scoliosis disorders. 5 samples of them were selected to get Theraline. The results of therapy showed that there was an improvement in the attitude and posture condition, especially the improvement of the scoliosis parameters. The conclusion of the study showed that scoliosis disorder was quite high among high school students. The cause is related to daily movement patterns, including sitting style while studying and how to carry a school bag. Theraline therapy given has a positive effect on the improvement of spinal alignment.*

### Introduction

Postural balance is one of the most important factors determining the ability of a person to make and maintain his/her movements. Adequate postural balancing is an important proof of proper neuromuscular control and communication between the central nervous system and muscles (Şahin&Akkaya, 2019).

One of the signs of healthy posture is the straightness of the spine (spine alignment). One form of spine alignment in children that can interfere with physical growth and physical fitness, especially posture and vertebral alignment is scoliosis. Scoliosis is a spinal alignment disorder that is commonly found among school students. The prevalence of scoliosis among school children, especially among high school students, is not yet known, and the cause has not been identified. This disorder needs to be corrected and one form of therapy for scoliosis sufferers is exercise therapy, with a prescription TheralineDiersFormetric.

However, no research has been found that has been conducted in Indonesia to calculate the frequency of scoliosis among schoolchildren. Meanwhile, vertebral posture and straightness are always measured as a component of testing or measuring children's physical fitness, but only by using simple measurement methods and tools with inaccurate results or low validity. In addition, there is no physical treatment or correction for this scoliosis disorder. The daily habit of students without realizing it when carrying a backpack or school bag is sometimes not used properly, they even tend to use it with loading on one side of the shoulder part of their body. This treatment then causes an imbalance in the alignment of the spine, which then results in abnormal growth and development of the structure. This present study aims to identify the presence of scoliosis in high school students, and to provide appropriate exercise therapy in cases of scoliosis. Expectations that are desired with the results of this study can be valuable input for students, physical education teachers in schools, to pay attention to the habits and behavior of students in providing motion treatment, burden their bodies to always pay attention to the balance of the load on their posture.

### Literature Review

Scoliosis is a spinal deformity consisting of lateral curvature and rotation of the vertebrae (Janicki & Alman, 2007).Scoliosis involves a lateral curvature of greater than 10°, often accompanied by a rotational defect (Kusumi&Dunwoodie, 2018).Scoliosis is defined as a three-dimensional (3D) structural deformity of the spine

and is diagnosed on the basis of a measurement of the major curves comprising the deformity (Cheng, 2015: 1). Idiopathic scoliosis is a three-dimensional deformation of the spine (de Sèze&Cugy, 2012).

Scoliosis is a form of spine misalignment which is characterized by the position of the spine that is not straight from the sagittal direction or tilted to the left or right. This situation interferes with the posture or firmness of physical appearance and will have a special impact on athletes in certain sports (Scoliosis Facts, 2013). Scoliosis can be found in school students, which occurs because of the pattern of daily physical activity, the habit of sitting in a learning position, the habit of carrying weights/bags, hobbies or sports. Janicki and Alman (2007) argue that the causes of scoliosis vary and are classified broadly as congenital, neuromuscular, syndrome-related, idiopathic and spinal curvature due to secondary reasons. Altaf, et. al (2013) argue that scoliosis can be categorized into three major types—congenital, syndromic, and idiopathic. Congenital scoliosis refers to spinal deformity caused by abnormally formed vertebrae. Syndromic scoliosis is associated with a disorder of the neuromuscular, skeletal, or connective tissue systems; neurofibromatosis; or other important medical condition. Idiopathic scoliosis has no known cause and can be subdivided based on the age of onset—infantile idiopathic scoliosis includes patients aged 0-3 years, juvenile idiopathic scoliosis includes patients aged 4-10 years, and adolescent idiopathic scoliosis affects people aged >10 years. However, most scoliosis belongs to the idiopathic scoliosis group with no clear cause (PN.Phan, 2011). Idiopathic scoliosis by definition is a disorder of unknown origin, therefore treatment is in response to symptoms (Bialek, 2011). The same comment from Lowe, et al (2000) who reveal that idiopathic scoliosis is a pathological entity of unknown etiology. The cause of idiopathic scoliosis is unknown and is a diagnosis of exclusion (El-Hawary&Chuckwunyerewa, 2014). Adolescent idiopathic scoliosis (AIS) is defined as a three dimensional spinal deformity with no identifiable causes in a growing child who is otherwise healthy (Weiss, et al (2016). Janicki and Alman (2007) stress that the majority of scoliosis cases encountered by the general practitioner will be idiopathic. Idiopathic scoliosis, occurring in 2-3% of the growing age population, is a developmental deformity of the spine and of the trunk (Bialek, 2011).

Many factors can affect scoliosis in a person, especially habits that are carried out unconsciously which then become a habit, such as walking abnormally, running and jumping and even the habit of imposing unbalanced body loads, abnormal sitting habits. This habit can indirectly affect the growth and development of posture and body structure of a person who experiences abnormalities in the spinal structure which eventually becomes scoliosis. Postural rehabilitation using scoliosis-specific exercise can be effective in the treatment of adolescent idiopathic scoliosis (AIS) patients when incorporated into daily life (Weiss, et al (2016).

The existence of scoliosis, especially the one that is still mild, is difficult and cannot even be found by ordinary observation or physical examination methods. For this reason, radiographic technology assistance is needed, including the "DiersFormetric" tool which will be used in this study. DiersFormetric is a 3-dimensional tool that can measure and describe the position of the spine in a static spine position and perform scoliosis case identification screening (DiersFamus, 2010; Patrick Knott, 2010).

#### What is spinal deformity?

Spinal alignment and curvature can be altered in many ways. They can occur as a result of a birth defect, a child's growth, aging, injury, or previous spine surgery. The most common type of spinal deformity in adults is degenerative scoliosis (Bohinski&Tempel, 2018). Bohinski and Tempel (2018) present the types of spinal deformities as follows:

##### Scoliosis

Scoliosis is a side-to-side curvature of the spine that can develop in adults when their facet joints and discs begin to deteriorate (Fig. 1). The facet joints give the spine flexibility, enabling us to twist, stretch, or curl up on the couch. When these joints deteriorate, the spine bones can tilt and begin to shift to one side.

##### Kyphosis

Kyphosis is an abnormal forward rounding (more than 50 degrees of curvature) of the spine. In the upper (thoracic) back, kyphosis is commonly due to osteoporotic compression fractures. It can also occur in the lower (lumbar) spine. It limits function and results in a common complaint among older people: "I can't stand up straight."

##### Lordosis

Also called swayback, lordosis is a condition in which the spine curves significantly inward at the lower back, giving a backward leaning appearance.

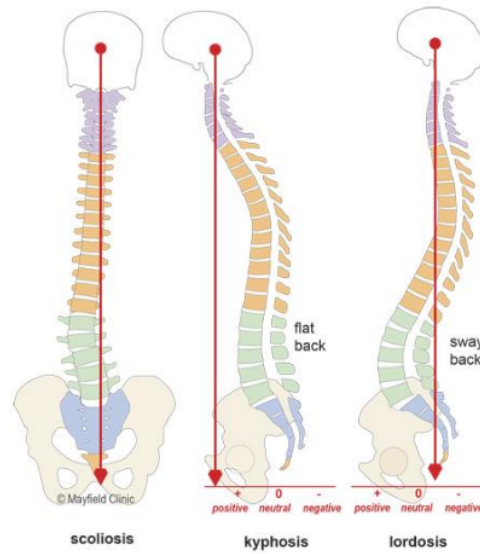


Figure 1. Types of spinal deformities: a side-to-side curve is called scoliosis; a forward curve (kyphosis) shifts the center of balance in front of the hip; a concave lower back (lordosis) thrusts the hips forward (Bohinski&Tempel, 2018).

The main parameters needed to diagnose posture and spinal alignment are (1) trunk imbalance (2) pelvic tilt (3) pelvic torsion (4) surface rotation (5) lateral deviation (6) kyphotic angle (max) (7). Lordotic angle (max). The seven parameters of this guide can be seen fully in the evaluation view output formetric, in addition to part of it can be seen in other view outs. These seven parameters were developed by Harzmann to provide limits for normal values and deviations in the diagnosis of spinal alignment. Harzmann's parameters in the diagnosis of scoliosis posture are: \* Pelvic obliquity: way above 4mm; \* Pelvic torsion: normal below 2 °, higher values pelvic torsion or functional disorder (ISG) ascertained in a differential diagnosis; \* Lateral deviation: above 5mm; \* Surface rotation: below 5 °. An overview of the formetric results and parameters of scoliosis and other vertebral alignment is seen in the following figure.

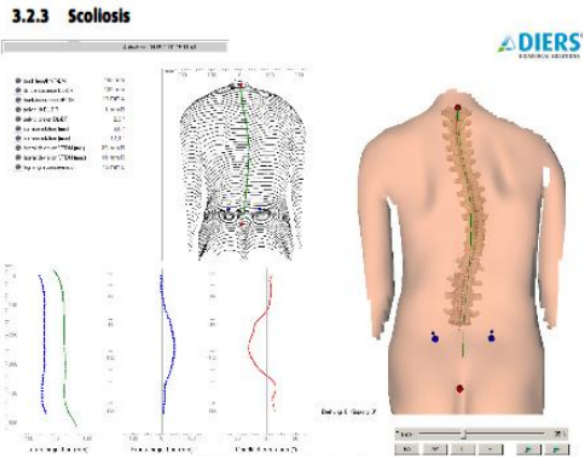


Figure 19: Patient with scoliosis with apex at TH11

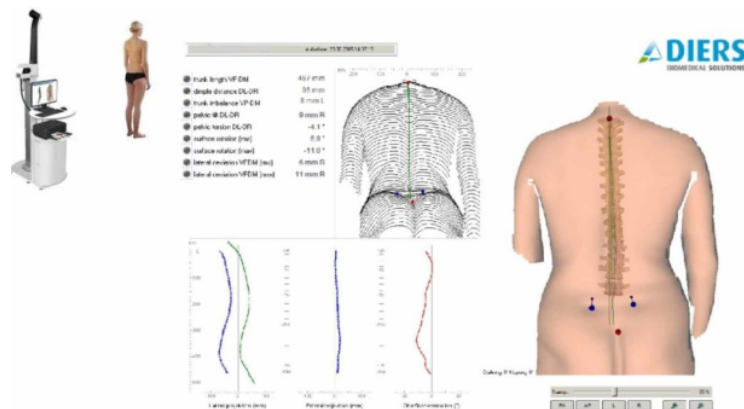


Figure 2: Evaluating trunk asymmetry in adolescents with idiopathic scoliosis using the DiersFormetrics 4D system (Diers International, Schlangenbad, Germany in Maragkoudakis, et al. (2019).

#### Picture. Formetric Results of Scoliosis Cases

##### Caption:

The diagnosis of scoliosis from the photo above is based on: (1) Pelvic obliquity (below 4 mm) (2) Pelvic torsion (normal below 2) = 2.3 degrees (3) Lateral deviation (far above 5 mm) = 23 mm (4) Surface rotation (above 4) = 6.6 degrees.

As a result, the body can be seen with body imbalance, seen with trunk imbalance (= 11 mm L), low left tilt 11 mm. This scoliosis case can be treated or rehabilitated by various methods, such as manual or physiotherapy, with the help of therapeutic tools and with exercise therapy (Scoliosis Exercise, Kaiser Permanente 2012; Kisner, C. Colby, 2008). In particular, DierFormetric prescribes a programmed therapy called Theraline (DiersFamus, 2010). This study will use and analyze the effectiveness of the application of the theraline program on cases of scoliosis for high school students in Makassar City.

This research is an effort to detect scoliosis early so that it has benefits in preventing the risk of advanced scoliosis, especially for school students who are still growing and prone to spinal disorders. This research is also an action research / exercise therapy, the results of which can be developed in physical education in schools and in the development of young athletes, and for the community as a community service program. In general, this study aims to find a form of scoliosis straightening treatment that is proven to be effective and significant so as to result in full rehabilitation of scoliosis cases. Specific objectives include: (a) Identification of high school students with scoliosis. (b) Identification and development of methods of physical exercise-based treatment (exercise therapy) according to TheralineFormetric recommendations. (c) Finding effective treatment methods in the rehabilitation of scoliosis disorders in school children.

#### Research Method

This study is a case analytic study of spinal alignment disorders in students. The population of this study were high school students in Makassar with a sample size of 29 people. Data collection by interview, questionnaire, and vertebral alignment examination using pedomformetrics. Data analysis from interviews and examination results was carried out by tabulating the characteristics of the students who had been examined and analyzing the effectiveness of the theraline training. The Formetric-Pedoscans measurement results were collected and analyzed using scoliosis diagnostic parameters. For this reason, it is calculated how many times children fall into the scoliosis category. From the scoliosis sample, 5 cases were selected to be given theraline therapy and analyzed the effectiveness of the exercises that had been done for 10 days.

#### Research Results and Discussion

Based on the objectives of the study as previously stated, the research results are presented as follows:

##### A. Characteristics of Students

##### 1. Gender Identity

The distribution of respondents based on gender of SMA Makassar Raya can be seen in table 1 below.

Table 1 Distribution of Respondents by Gender SMA Makassar Raya

	F	%
Male	13	44,8
Female	16	55,2
Total	29	100

Source: Primary Data

The table shows that the male gender is 13 people (44.8%). Meanwhile, there were 16 women (55.2%).

## 2. Age distribution

The age distribution of Makassar Raya high school students can be seen in table 2 below.

Table 2 Age Distribution of Makassar Raya High School Students

Age (Year)	F	%
14-15	11	37,9
16-17	18	62,1
Total	29	100

Source: Primary Data

The table shows that there were 11 respondents aged 14-15 years (37.9%). Meanwhile, 18 people aged 16-17 (62.1%).

## 3. Parents' Work

The distribution of respondents based on the occupation of parents at SMA Makassar Raya can be seen in the table below

Table 3

Distribution of Respondents Based on Parents' Occupation

SMA Makassar Raya

Parents' Job	F	(%)
Does not work	4	13,8
Construction workers / laborers	14	48,3
Fishermen / farmers	5	17,2
Traders / entrepreneurs	1	3,4
PNS / POLRI / TNI / BUMN / Retired	1	3,4
General employees	4	13,8
Total	29	100

Source: Primary Data

The table shows that 4 (13.8%) parents do not work based on their parents' work, 14 people (48.3%) are construction workers / laborers, 5 people (17.2%) fishermen / farmers, 1 person (3.4%) traders / entrepreneurs, 1 person (3.4%) civil servants. And 4 people (13.8%) who work as private employees

## B. Healthy Lifestyle and Physical Activities of Students

### 1. The state of everyday health

The daily health condition of Makassar Raya high school students can be seen in table 4 below.

Table 4 Distribution of Students' Daily Health Conditions SMA Makassar Raya

Daily Health Condition	F	(%)
Always healthy	13	44,8
Normal healthy	4	13,8
Sometimes mild pain	10	34,5
Often sick	2	6,9
Total	29	100

Source: Primary Data

The table shows that 13 people (44.8%) are always healthy, 4 people (13.8%) are normally healthy, 10 people (34.5%) are sometimes sickly, and as many as 2 people (6.9%) were often sickly.

## C. Student Characteristics

### 2. The State of Everyday Health

Daily Health Condition	F	(%)
Always healthy	13	44,8
Normal healthy	4	13,8
Sometimes mild pain	10	34,5
Often sick	2	6,9
Total	29	100

Based on the table above, it shows that 13 people (44.8%) are always healthy, 4 people (13.8%) are normally healthy, 10 people (34.5%) are sometimes sickly, and as many as 2 people (6.9%) were often sickly.

### 3. Previous illness history

<b>Serious Illness and Hospital Admission</b>	<b>F</b>	<b>%</b>
Never	24	82,8
Yes/Ever	5	17,2
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, it shows that there were 24 respondents who had never experienced serious illness and were admitted to the hospital (82.8%) and had experienced serious illness, while 5 people (17.2).

### 4. Student Learning Position

<b>Learning Position</b>	<b>F</b>	<b>%</b>
Face Down	1	3,4
Sit Face Down	3	10,3
Sit	4	13,8
Sit on a chair with a table	21	72,4
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, of the 29 student respondents who study on their stomachs 1 person, 3 people sit and face down, usually 4 people sit, and the remaining 21 people (72.4%) sit studying on a chair using a table.

### 5. Habits of Carrying School Bags

<b>Bag Type</b>	<b>F</b>	<b>%</b>
Sling bag	16	55,2
School backpack	13	44,8
Arm	0	0
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, it can be seen that of the 29 students of SMA Makassar Raya who use side bags as many as 16 people (55.2%), use school backpacks as many as 13 people (44.8%) and there are no students who use the bag with the handbag type.

### 6. Position of Carrying Bag

<b>The habit of carrying bags</b>	<b>F</b>	<b>%</b>
Left / right shoulder bag	17	58,6
Left / right shoulder sling backpack	4	13,8
Backpack on the shoulders / shoulder	8	27,6
Carrying bags	0	0
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, it can be seen that as many as 17 people (58.6%) carried a side bag on the left / right shoulder, 4 people (13.8%) carried a bag by means of a left / right shoulder sling, and as many as 8 people (27.6%) carried a backpack. on the shoulders / shoulder, and not found by students carrying a bag.

<b>Breakfast Habits</b>	<b>F</b>	<b>%</b>
No breakfast	14	48,3
Drinking tea	4	13,8
Milk	3	10,3
Fried rice	2	6,9
Egg rice	5	17,2
Bread	1	3,4
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, there are as many as 14 people (48.3%) of respondents who do not eat breakfast, while the respondent with the habit of eating bread is 1 person (3.4%) which is the lowest breakfast habit.

<b>Breakfast Frequency</b>	<b>F</b>	<b>%</b>
Never	3	10,3
Very rarely	9	31
Rarely	7	24,1
Often	4	13,8
Always	6	20,7
<b>Total</b>	<b>29</b>	<b>100</b>

5 Based on the table above, it can be seen that the frequency of students who never eat breakfast is 3 people (10.3%), students who rarely eat breakfast are 9 people (31%), students who rarely eat breakfast are 7 people (24.1%). There were 4 students who often ate breakfast (13.8%), while the frequency of students who always ate breakfast was 6 people (20.7%).

Eat Snacks at Mealtime	F	%
Very often	6	20.7
Often	11	37.9
Rarely	5	17.2
Once in a while	7	24.1
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, it can be seen that there are 6 (20.7%) students who often eat snacks at mealtimes, 11 (37.9%) students often snack, 5 (17.2%) students rarely snack and 7 (24.1%) students occasionally eat snacks at mealtimes.

#### 7. Daily Physical Activity Transportation to School

Physical activity	f	%
Ride on Vehicle (motorbike / car)	12	41.4
On foot	17	58.6
Riding a bicycle	0	0
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, there were 12 (41.4%) students who used to ride vehicles (cars / motorbikes), 17 (58.6%) students walked and there were no students who used bicycles.

#### 8. Sports Hobby

Sports Hobby	f	%
Soccer	12	41.4
Swimming	2	6.9
Gymnastics	1	3.4
Volleyball	11	37.9
Basketball	3	10.3
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, there are 12 students with the most hobbies sports, namely football (41.4%). Meanwhile, the students with the lowest sports hobbies were gymnastics with a frequency of 1 person (3.4%).

#### B. Pedoformetric examination

##### 1. Overview of Formetric Shoulder Balances (Trunk Imbalance)

Imbalance	f	%
Normal	13	44.8
Abnormal	16	55.2
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, there were 16 people (55.2%) who had abnormalities (abnormal) and 13 people (44.8%) who had no abnormalities (normal).

##### 2. Kyphosis Angle examination

Kyphosis	f	%
Normal	22	75.9
Abnormal	7	24.1
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, there were 7 people (24.1%) who had kyphosis abnormalities (abnormal) and 22 people (75.9%) who had no abnormalities (normal).

##### 3. Formetric examination of Lordosis Angle

Lordosis	f	%
Normal	24	82.8
Abnormal	5	17.2
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, there were 5 people (17.2%) who had lordosis (abnormal) and 24 people (82.8%) who had no abnormalities (normal).

##### 4. Formetric Examination of Scoliosis



Scoliosis	f	%
Normal	16	55.2
Abnormal	13	44.8
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, there were 13 people (44.8%) who had sceliosis (abnormal) and 16 (55.2%) who had no abnormalities (normal).

#### 5. Overview of Pedoscan Examination

Pedoscan	f	%
Balance	9	31.0
Imbalance	20	69.0
<b>Total</b>	<b>29</b>	<b>100</b>

Based on the table above, there were 20 people (69.0%) who had pedoscan abnormalities (imbalance) and 9 people (31.0%) who had no abnormalities (balance).

#### D. Theraline Therapy for Scoliosis Disorders

From the results of the examination of 29 respondents of SMA Makassar Raya, there were 5 students who had vertebral alignment disorders and were used as samples or cases to do scoliosis therapy exercises. Five selected students were examined for the physical condition of the vertebrae before and after receiving theraline therapy. Cases with formetric scoliosis and their description before and after theraline therapy are shown in the following table:

#### Changes in Scoliosis Parameters Before and After Theraline SMA

No	Case	Scoliosis	
		Pre	Post
1	Mih	25	23
2	Rhm	3	3
3	Snt	3	0
4	Nbl	8	10
5	Nrn	16	3

Changes in scoliosis may be accompanied by changes in other parameters resulting from a formetric picture. An overview of the overall changes that occur in Trunk Imbalance, Kyphosis, Lordosis and Scoliosis itself can be seen in the table below.

#### Pedofometric overview of cases before and after exercise therapy

No	Name	Formetric Examination							
		Trunk Balance		Kyphosis Angle		Lordosis		Scoliosis	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	Mih	2 mmL	2 mmL	49	45	21	22	25	23
2	Rhm	24 mm	12 mmR	69	58	60	53	3	3
3	Snt	5 mmL	3 mmL	46	30	29	31	3	0
4	Nbl	2	2	46	48	33	36	8	10
5	Nrn	14	5	64	53	73	44	16	3

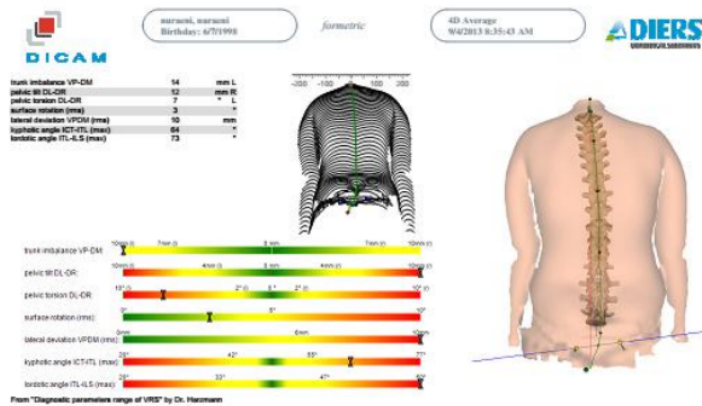
Based on the table above, it can be seen from the 5 students who took theraline exercise therapy, there were 2 students who experienced changes in the spine. This can be seen from the formetric examination of cases that experienced abnormalities before doing exercise therapy and experiencing changes after doing exercise therapy. Meanwhile, 3 students did not experience significant changes.

E. Case AnalysisOf the 5 cases who received exercise therapy, an in-depth analysis was carried out on one case that experienced a significant change or improvement in scoliosis after receiving theraline. Case Nrn, female student, 16 years old, height 151, weight 57, hobbies reading, see the following table. His formetric examination showed an abnormal balance of the shoulder (right tilt 14 mm) and scoliosis angle. 16. After 10 days of therapy, there was a significant change and a normal posture with a trunk imbalance of 5 mm and a decreased scoliosis angle of up to 3 mm.

#### Vertebral Alignment State Description Case Ms.

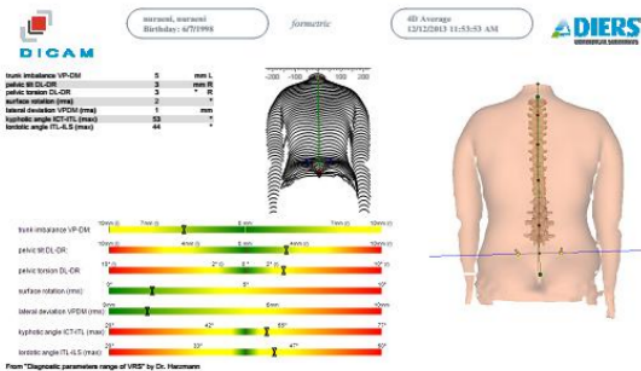
No	Name	Formetric Examination							
		Trunk Balance		Kyphosis Angle		Lordosis		Scoliosis	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post
5	Nrn	14	5	64	53	73	44	16	3

The formetric photo of Ms. Nrn's case can be seen in the image below



Diets International GmbH, Dillenbergsweg 4, 65388 Georgenbarn info@diets.de +49(0)612948860

Figure 2. Formetric photo of pre-exercise sports case Nrn



Diets International GmbH, Dillenbergsweg 4, 65388 Georgenbarn info@diets.de +49(0)612948860

Figure 3. Formetric photo post sports training case Nrn

### Conclusion and Suggestion

Of the 29 students, it was found that 13 (44.8%) had scoliosis disorders. Five of the students were selected to do Theraline therapy. The result of therapy shows that there has been an improvement in the attitude and posture conditions, in particular the improvement of scoliosis parameters. Scoliosis disorder is quite high among high school students. The cause is related to daily movement patterns, including sitting style while studying and how to carry a school bag. Theraline therapy given has a positive effect on the improvement of spinal alignment. Based on theraline therapy that was carried out by students for 10 days, there were 2 students who experienced changes in the spine but there were 3 students who did not experience significant changes in their spine, this was because the students were not routine and serious about doing theraline exercise therapy. For students, always behave in an active life and have a daily movement pattern that can avoid balance disorders and maintain spinal alignment. So that students do physical movements and sports that do not give too much weight on one side or exercise that has excessive intensity so that it puts heavy loads on the spinal column. For students who have spinal disorders, they should routinely do theraline therapy exercises. For sports teachers, always foster student physical education activities that can maintain spinal alignment and posture straightness.

For school principals, develop a curriculum that contains discussion material on healthy daily movement patterns in maintaining posture and spinal alignment.

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