

Case Report

Ruku's Position Might Improve Scoliosis Curve Angles of 18-Years Old Female with Mild Thoracic Adolescents Idiopathic Scoliosis: A Case Report

Olympia Zahradewi¹, Eko Ari Setijono², Trianggoro Budisulistyo³, Yuyun Yueniwati⁴

Abstract

Adolescent idiopathic scoliosis with an incidence of around 2%, commonly affects thoracic regions. The functional curves or structural treatment cannot be managed by the muscle's active force and the Ruku' movement on Moslem prayer led paravertebral muscles to gently bend with consistent forces and improve mild thoracic AIS in 4-week. An 18-year-old female diagnosed with mild thoracic AIS carried out treatment by improving Ruku movements regularly for 4-5 minutes from August 12 to September 12, 2022. The formed angle by an imaginary line of Th 4 and Th 9 *spinal processes*, showed improvement (2.42% to 4.24%). Another study that used core stabilization training can also resolve AIS for 12 weeks, 3 sessions/week, and with 60 minutes/session. Thus, consistent Ruku's movement in the proper position promotes the spinal column remaining in the midline, so might correct the mild thoracic AIS's misaligned, support ergonomic position, and make the patients not easily tired.

Keywords: *Cobb Angle*, Ruku's position, thoracic scoliosis

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Introduction

Scoliosis is an example of an abnormality in the spine. Scoliosis is categorized into several types, namely idiopathic, congenital, neuromuscular, and syndromic. Of those many types, idiopathic scoliosis has become the most common type of scoliosis suffered by adolescents and can also be referred to as Adolescent Idiopathic Scoliosis (AIS).^[1] It is the one type of scoliosis that often affects adolescents around the world and globally has impacted 2.5% of the total adolescent population in the world in 2015. The cause of this disease is unknown among 80-85% of patients with AIS, but generally, an incidence of about 2% can affect the thoracic region of adolescents and cause CNS (Central Neuron System) abnormalities in various study series.^[1,2] It is divided based on the stages, namely mild (early stages), moderate, and severe (late stages). The treatment of AIS which is still categorized as early stages (*cobb angle*

10-25°) is said to be more cost-effective than the treatment after the occurrence of an acute stage in other studies. Several hypotheses have also been put forward to find appropriate, fast, inexpensive, and not tiring treatment that can be carried out by sufferers of this disorder, but to no avail. Treatment in the early stages, which is said to be cheaper than acute treatment, still takes a long time to see changes in the *cobb angle*. Therefore, new solutions that can solve the early-stage AIS problem need to be investigated. With the criteria, it does not require a lot of money, can be done anywhere, and can only take a short time.^[3]

Ruku' is one of the movements carried out by adherents of Islam. Ruku' is done before prostration and after reading a short prayer in the Qur'an. The movements achieved during ruku' are conducted by facing the thorax and head to look at the floor which forms a 90° angle while making both palms clasp the feet and cover the *patella* area (thumb

1. Faculty of Medicine Brawijaya University, Malang Indonesia
2. Neurology department, Faculty of Medicine, Brawijaya University, Malang Indonesia
3. Neurology department, Faculty of Medicine, Diponegoro University, Semarang Indonesia
4. Radiology department, Faculty of Medicine, Brawijaya University, Malang Indonesia

Correspondence to: Olympia Zahradewi, Student, Faculty of Medicine Brawijaya University, Malang Indonesia, E-mail: olymp.zahra2004@gmail.com

and index finger cupping the *patella* area). The bowing motion in this study was first hypothesized in the world to slowly bend the paravertebral bones of sufferers with consistent strength. This might reflect of spinal muscles pull maximally has the possibility to cause the spine to slowly return to its normal position or to the midline. So can lead to better vertebra column alignment which muscles and supportive tissues are in the proper position.^[3]

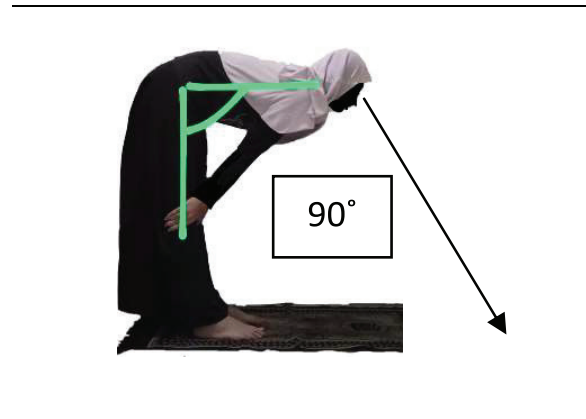
Scoliosis cannot be justified by the dysfunction or wrong movement of active muscles, as some cases might cause by the sitting bent habit or compromise to the comfort side due to musculoskeletal or disc problems. Ruku' makes the spinal muscles pull maximally has the possibility to cause the spine to slowly return to its normal position or to the midline, so we thought that it could be improved for managing AIS problems.

Materials and Method

The subject that's being used in this study was an Indonesian woman aged 18 years old and suffering from mild thoracic AIS without mechanical or sport traumatic injuries before. She also did not have any severe disease in the thoracic area during the study. She was observed having mild thoracic AIS beforehand, which an initial *Cobb Angle* of 20° on its right thorax and with *spinous processes* of 165° . The most frequently reported complaint during this mild thoracic AIS is that she always gets tired faster than her friends in carrying out activities while she has difficulty breathing or hyperventilation. The thoracic X-ray was taken at Dr. Kariadi Hospital in Semarang, then followed for 1-month observation as ordered by one radiologic weekly examination at Radiology Department in Malang.

The study was conducted over the range of a month or four weeks. Starting on August 12th and ending on September 12th, 2022. The implementation of the ruku' movement or bowing by 90° and looking at the floor is shown in **Figure 1**. This ruku' movement is carried out in every prayer each session takes 4-5 minutes. Within a day, normally the bowing movement is performed 17 times (2 bowing in one-morning prayer, 4 bowing in 3 times in the afternoon-evening-night prayers, and 3 times bowing in one maghrib prayer). Considering this, the study was mobilized to be carried out with a total of 17 bowing times and carried out consistently within the implementation period. The implementation of the research was

carried out by the subjects in private boarding rooms and at the campus mosque; in Malang.



The radiological results obtained will be used as a measure of this study. Radiological results were calculated using the *Cobb Angle* formula.^[4,5,6,7] If the angle that's being made is $<10^\circ$, then the bones of the subject are normal. Mild is in the $10-25^\circ$ angle range, moderate is $25-45^\circ$, and severe is $>45^\circ$. In addition to using the *Cobb Angle*, the measurement also measures the *spinous process* or tissue sticking out of the plate of the spinal organ. The *spinous process* is measured using the degree of measurement on the curved part only in the midline of the spine.

In this study, the results of the *Cobb Angle* and the *Spinous Process* will be measured using a certain formula using angles and then divided by the correlation per week and per day. The *Cobb Angle* in this innovation will be referred to as CA and the *Spinous Process* will be referred to as PS. Both things will be measured using a structure like this:

The above method formula is used with the aim of being able to see the degree of spinal changes of the patient every day or every week. This formula is used with the aim that the X-ray results passed in the second week can still be able to be calculated validly. This study also will show how long do the subject's vertebrae doing their job per day. Those jobs included sitting down and walking or standing up. In addition to that information, the result of this study will also show how many times Ruku' has been done by the subject per week to show whether the intensity of doing the Ruku' movement in everyday life can really straighten the paravertebral curve in scoliosis sufferers and maintain the good posture in everyday life.

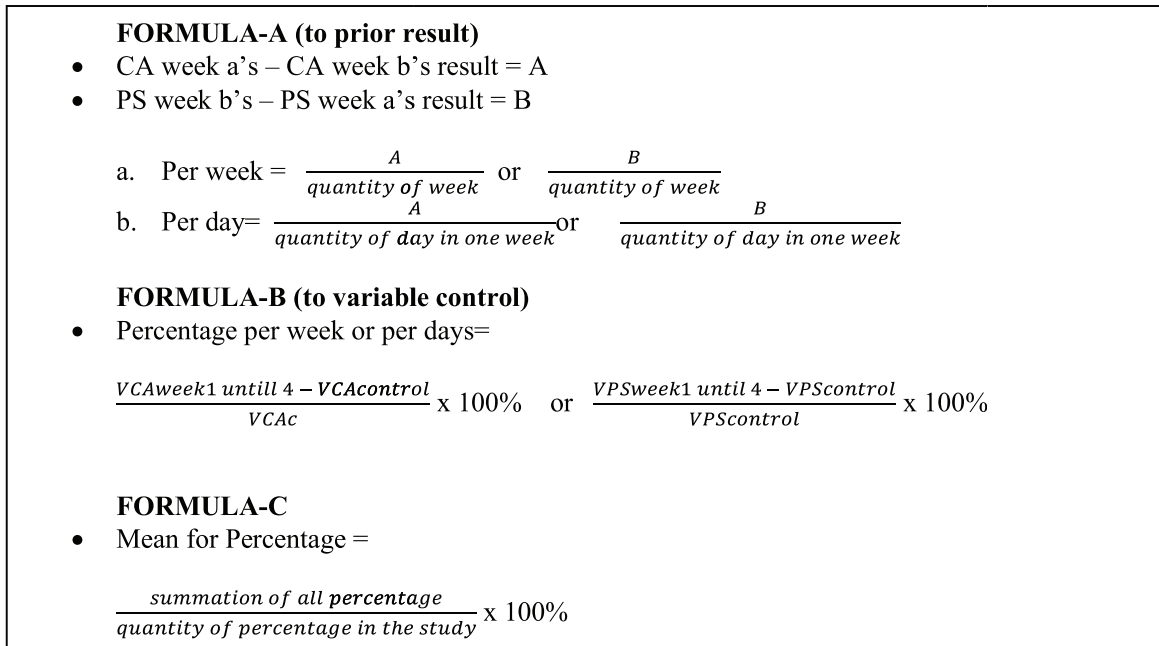


Figure 2: The specific formula for the result's discussion

Furthermore, in this study, the authors declared that the method that's being used does not violate any points in the WMA Declaration of Helsinki about Ethical Principles for Medical Research Involving Human Subject 2000 such as the respecting subject's safeness and rights.

Results

From the study that's being carried out, it was found that the study of the *Cobb Angle* of the spine which had an initial tilt angle of 20° to the right could drop to 9° and the initial *spinous process* (165°) on 18 years old could be corrected to 172° within 4 weeks. Using the chronological movement of Muslim prayer, starting from raising the hand to sitting down, the paravertebral or the vertebrae of the sufferer can deform to their original normal shape which is shaped straight to the midline of the body or linear to the cranial bone of the body. Even though a few important points that have been done need to be reconsidered in the future experiment and this study. Those points are provided below along with the following head-ups about what's going to be discussed in the next chapter.

The radiological examination with concerned about a health matter, as the continuous X-ray exposure was not more than 4 times with 1-week intervals. So, the study was started 2 weeks after the initial exposure. This action was being taken to be dismissed due to the health matter of the subject when being exposed to the X-ray light. Other than

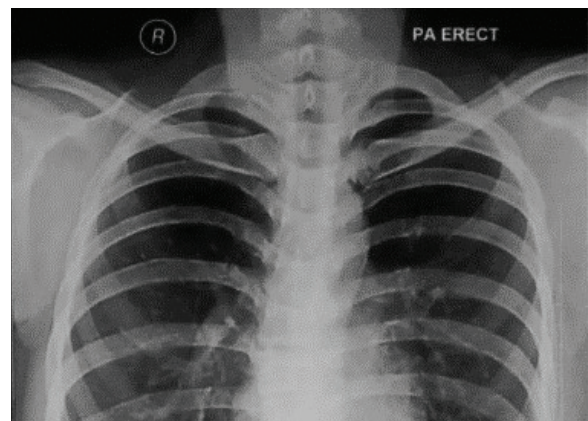


Figure 3: Variable control; Right *Cobb Angle* 20° and with *Processus spinosus* of 165°

that, in the execution of the study that's being held, the subject has skipped a few times of the daily prayer in the following week (week-2) which is being converted into days will interpret as 2 days without 17 times movement of Ruku' per day. Other additional information for this result is that in the period time of the experiment, the subject always sat down and walk or stood up in less than eight hours. The duration of these activities has a certain relationship with the change in the vertebrae's shape. Without specific measurement or being looked up closely and with the objective measurement, the changes that occur in the vertebrae of the subject can be seen vividly.^[8] The changes in vertebrae angle in the data seem to be

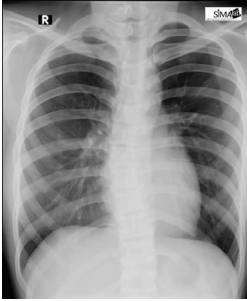
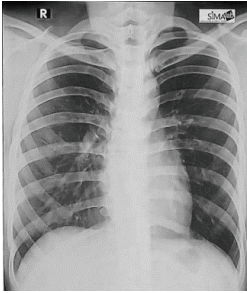
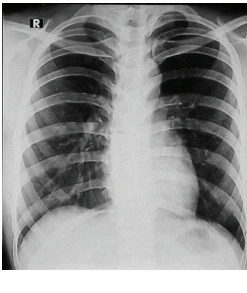
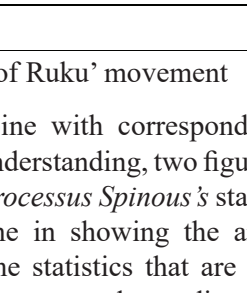
Day	Sitting Down		Standing Up/ Walking		Total Raka'at/ruku'	X-ray Thorax	Result
	<8 hours	>8 hours	<8 hours	>8 hours			
1.	√	-	√	-	17x7 = 119		Date: 22-8-2022
2.	√		√				CA: 20°; PS: 169°
3.	√		√				-0,0° CA changes/day
4.	√		√				-0,0° CA changes/week
5.	√		√				-0,57° PS changes/day
6.	√		√				-4° PS changes/week
7.	√		√				
8.	√		√		(17x5) = 85		
9.	√		√				unidentified.
10.	√		√				
11.	√		√				
12.	√		√				
13.	√		√				
14.	√		√				
15.	√		√		17x7 = 119		Date: 5-9-2022
16.	√		√				CA: 15°; PS: 170°
17.	√		√				-0,71° CA changes/day
18.	√		√				-5° CA changes/week
19.	√		√				-0,14° PS changes/day
20.	√		√				-1° PS changes/week
21.	√		√				
22.	√		√		17x9 = 153		Date: 12-9-2022
23.	√		√				CA: 9°; PS: 172°
24.	√		√				-0,66° CA changes/day
25.	√		√				-6° CA changes/week
26.	√		√				-0,22° PS changes/day
27.	√		√				-2° PS changes/week
28.	√		√				
29.	√		√				
30.	√		√				
476times							

Figure 4: The result table of Ruku' movement

starting from the upper vertebrae near the cranial and then slowly changing the vertebrae area near the lumbar bones. This can happen because thoracic bones are much evolutivethan lumbar bones and can increases through disc wedging during the rapid growth spurt later.^[9]

Discussion

The results above show that the movement of Ruku' can make changes in the curvature of the

spine with corresponding changes. To simplify understanding, two figures below: *Cobb Angle* and *Processus Spinous's* statistics, will show a shifting line in showing the angle degree of vertebrae. The statistics that are showed a declining angle degree or descending line (**Figure 5**), and an inclined angle degree known as the ascending line (**Figure 6**). Those lines with similarities meant, that observing the improvements in scoliosis alignments might give positive feedback. Using

the formula that's present in the Method and Material chapter above, the degree changes from variable result A to the prior variable result, and the percentage of the effectiveness of the utility of the conducted movement can be seen. The resulting degree that will be shown in two measurements is divided into classifications: per week degree or days degree.

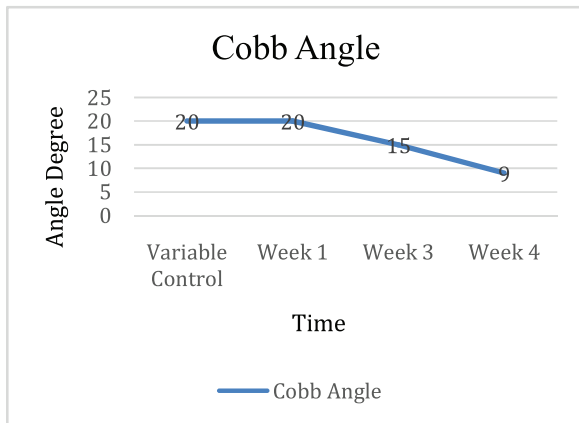


Figure 5:The decreasing degree of *Cobb Angle*

Formula per week for shifting tilt started from week-1. It was seen that in the named week there were no changes in the *Cobb Angle* (0,0°) according to the variable control as the prior variable result while the *Processus Spinous* of this variable result shows about 4° changes for one week and 119 Ruku' movement in the week. Skipping the variable result in week-2, and week-3 shows that there are 5° CA changes and 1° PS changes from week-1 for 119 Ruku' movement. If the division of the existing degree of CA and PS in week-2 is merged with the degree changes in week-3, then in each week there will be 2.5° CA and 0.5° PS degree changes with a total of 204 Ruku' movement. For week-4, the changes degree of CA and PS from the prior variable is 6° for 153 Ruku' movement.

The formula per day for shifting tilt starting from week-1 shows about 0.0° CA changes and 0.57° PS changes. Skipping week-2, and week-3 have 0,71° CA changes per day and 0.14° PS changes. If the degree changes between week-2 and week-3 are being merged, then the final output of its number is 0.35° CA and 0.07° PS angle degree. Lastly, the week-4 of this experiment showed that from the prior experiment, the CA of the sufferers is 0.66° while the PS changes to 0.22°. The percentage of the existing data in each week will be shown using Formula B and Formula C (**Figure 2**).

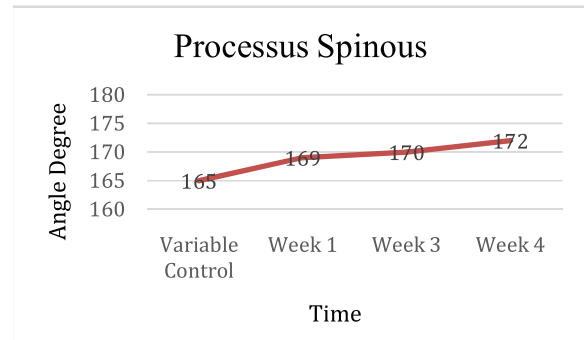


Figure 6:The increasing angle degree of *Processus Spinous*

The measurement above observed CA and PS changes (26.6% and 3.23%) (**Figure 7**), wherein priorly the core stabilization treatment might improve 15.5% of the *Cobb Angle*.^[10] Otherwise, in this study, the proper ergonomic posture could play role in the improvements, but the movement needs to be done correctly and regularly especially for early AIS patients (10-14 years old) due to the body growth spurt so that their vertebrae can grow normally and stay in the midline.^[11]

Regarding muscle mechanics, most practice uses muscle traction to simulate the curved muscles on spinal loading such as muscle traction forces between origin and curved muscle insertion that are typically transmitted to the vertebral bodies or other body parts via “passing points” making contact forces between muscles and vertebral bodies to simulate proper action that wraps around the muscle. Therefore, future research about muscle can be pursue. For example, the examination of soft tissue deformation during changes in posture or movement to understand the realistic physiological properties of muscles during exercise, the information about the complexity of asymmetric loads that combine motion in three-dimensional space to see significantly increase the risk of spinal injury, and to see whether it can be personalized for one person and applied to many people.^[12]

Conclusion

In this study, it was found that doing daily prayer in everyday life and performing the movement of Ruku' properly can improve vertebral column position. When the position of the backbone is correct and the paravertebral muscles can support an ergonomic position, our body will unable to easily feel tired. With the correlation of the data above that shows the consistency and lots

FORMULA-A (to prior result)

Per week

Week-1 = CA 0°, PS 4°

Week-3 = CA 5°, PS 1°

Week-4 = CA 6°, PS 2°

Per day

Week-1 = CA 0,00°, PS 0,57°

Week-3 = CA 0,71°, PS 0,14°

Week-4 = CA 0,66°, PS 0,22°

FORMULA-B (to variable control)

1. Week-1 = a. CA: $\frac{20^\circ - 20^\circ}{20^\circ} \times 100\% = 0\%$
b. PS: $\frac{169^\circ - 165^\circ}{165^\circ} \times 100\% = 2,42\%$
2. Week-3 = a. CA: $\frac{20^\circ - 15^\circ}{20^\circ} \times 100\% = 25\%$
b. PS: $\frac{170^\circ - 165^\circ}{165^\circ} \times 100\% = 3,03\%$
3. Week-4 = a. CA: $\frac{20^\circ - 9^\circ}{20^\circ} \times 100\% = 55\%$
b. PS: $\frac{172^\circ - 16^\circ}{165^\circ} \times 100\% = 4,24\%$

FORMULA C

$$\text{Summation} = \text{a. CA: } \frac{(0+25+55)\%}{3} = 26,6\%$$

$$\text{b. PS: } \frac{(2,42+3,03+4,24)\%}{3} = 3,23\%$$

Figure 7: Raising percentage of the changes in degree from variable control to week-4

of amount, it will deform scoliosis back to the normal shape faster than the ones that didn't. We realize that the long-term duration of the study, subject participants, and early moderate stages of scoliosis could describe the effectiveness of the treatment.

Limitations

The limitation or lack of this research is that the participant is limited and more subjects needs to be involved. The variables that are being analyzed also should be more varied, such as length of activity sitting, standing, exercise, body mass index, age groups, etc.

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radiology examinations are done at Dr. Kariadi Hospital Semarang and SIMA Laboratory Malang in Indonesia.

Author Contributions

OZ designed the study, performed the experiment, and study's subject. Together with EA, TB and YN to analyzed the data and wrote whole the publication article. YN advices for X-ray observation and *Cobb Angle* measurements during the study. EA and TB monitored the execution and how it can cause the nervous system.

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Conflicts of Interest

The authors declare no conflicts of interest.

References

1. Berdishevsky H, Lebel VA, Bettany-Saltikov J, Rigo M, Lebel A, Hennes A, et al. Physiotherapy scoliosis-specific exercises –a comprehensive review of seven major schools. *Scoliosis and Spinal Disorders*. 2016; 11:20. <https://doi.org/10.1186/s13013-016-0076-9>
2. Elattar EA, Saber NZ, Farrag DA. Predictive factors for progression of adolescent idiopathic scoliosis: a 1-year study. *Egyptian Rheumatology and Rehabilitation*. 2015; 42(3): 111–9. <https://doi.org/10.4103/1110-161X.163943>
3. Hefti F. Pathogenesis and biomechanics of adolescent idiopathic scoliosis (AIS). *J Child Orthop*. 2013; 7: 17–24. <https://doi.org/10.1007/s11832-012-0460-9>
4. Al-Zubaer Imran A, Huang C, Tang H, Fan W, CheungKMC, To M. Analysis of Scoliosis From Spinal X-Ray Images. *Electrical Engineering And Systematic Science*. Cornell University, April 2020. <https://doi.org/10.48550/arXiv.2004.06887>
5. Keenan BE, Adam CJ, Percy MJ, Pettet GJ. Medical Imaging And Biomechanical Analysis Of Scoliosis Progression In The Growing. Queensland Univeristy of Technology. https://eprints.qut.edu.au/84532/1/Bethany%20Elin_Keenan_Thesis.pdf
6. Malfair D, Flemming AK, Dvorak MF, Munk PL, Vertinsky AT, et al. Radiographic Evaluation of Scoliosis. *American Journal of Roentgenology*. 2010; 194: S8-22. <https://doi.org/10.2214/AJR.07.7145>
7. Jeb McAviney J, Roberts C, SullivanB, AlevrasAJ, Petra L GrahamPL, Brown BT. The prevalence of adult de novo scoliosis: A systematic review and meta - analysis. *Eur Spine J*. 2020; 29(12): 2960-9. <https://doi.org/10.1007/s00586-020-06453-0>
8. Wang J, Zhang J, Xu R, Chen TG, Zhou KS, Zhang HH. Measurement of scoliosis Cobb angle by end vertebra tilt angle method. *J Orthop Surg Res*. 2018; 13(1): 223. <https://doi.org/10.1186/s13018-018-0928-5>
9. Will RE, Stokes IA, Qiu X, Walker MR, Sanders JO. Cobb Angle Progression in Adolescent Scoliosis Begins at the Intervertebral Disc. *Spine (Phila Pa 1976)*. 2009 Dec 1;34(25):2782-6. <https://doi.org/10.1097/BRS.0b013e3181c11853>
10. Qi K, Fu H, Yang Z, Bao L, Shao Y. Effects of Core Stabilization Training on the Cobb Angle and Pulmonary Function in Adolescent Patients with Idiopathic Scoliosis. *J Environ Public Health*. 2022: 4263393. <https://doi.org/10.1155/2022/4263393>
11. Sung S, Chae HW, Lee HS, Kim S, Kwon JW, Lee SB, et al. Incidence and Surgery Rate of Idiopathic Scoliosis: A Nationwide Database Study. *Int. J. Environ. Res. Public Health*. 2021; 18: 8152. <https://doi.org/10.3390/ijerph18158152>
12. Jaejin Hwang, Gregory G. Knapik, Jonathan S. Dufour & William S. Marras Curved muscles in biomechanical models of the spine: a systematic literature review, *Ergonomics*, 2017; 60:4, 577-588, <https://doi.org/10.1080/00140139.2016.1190410>