OFFICIAL TITLE OF THE STUDY

Investigation of The Effects of Lumbopelvic Rhythm on Postural Control, Daily Living Activities and Quality of Life in Adolescent Individuals with Idiopathic Scoliosis

NCT NUMBER

NCT Number: Not yet assigned

DOCUMENT DATE:

23 January 2026

WORKING PROTOCOL

1. Name of the Study

Investigation of the Effect of Lumbopelvic Rhythm and Postural Control on Activities of Daily Living and Quality of Life in Adolescent Idiopathic Scoliosis

2. Rationale and Purpose of the Research

Adolescent idiopathic scoliosis (AIS) is a condition that develops during adolescence and causes a three-dimensional deformity of the spine. This deformity can include deviations in the frontal, sagittal, and axial planes and can negatively affect individuals' physical functions and balance control mechanisms. (1). Lumbopelvic rhythm refers to the coordination of spinal and pelvic movements and is a critical factor for postural stability. Scoliosis can alter lumbopelvic rhythm by affecting pelvic and lumbar region movements (2). In individuals with AIS, changes such as decreased trunk flexion-extension movements and pelvic and hip movements during walking, overactivity of muscles in the spine and pelvis, increased energy consumption, impaired balance and gait have been observed (3,4). Abnormalities in vestibular and proprioceptive inputs have also been observed, leading to changes in balance control (5 , 6). Postural control requires the integration of sensory and motor systems to maintain body balance. Changes in postural control mechanisms in individuals with scoliosis can reduce mobility. In postural control assessments, individuals with scoliosis have been found to exhibit greater deviation and acceleration reactions from the center of pressure compared to healthy individuals (7 , 8). This can lead to difficulties in daily living activities, increased pain levels, and decreased quality of life (9, 10). While there are studies in the literature on muscle activation, range of motion, pelvic position, gait, and balance in individuals with AIS, no studies have been found that examine changes in lumbopelvic rhythm and their relationship with the type, localization, and severity of the curve, and the effect of lumbopelvic rhythm on postural control and quality of life in individuals with AIS. Therefore, evaluating lumbopelvic rhythm in individuals with AIS can contribute to understanding the changes in movement patterns due to scoliosis and guide clinical diagnosis and treatment approaches.

The purpose of this study is;

- To identify possible differences by comparing the lumbopelvic rhythm characteristics of individuals with AIS to those of healthy individuals.
- To investigate the effects of localization, type, and severity of curvature on lumbopelvic rhythm in individuals with AIS.
-To examine the lumbopelvic rhythm in individuals with AIS during daily living activities such as trunk flexion and extension, sitting down, standing up, and walking.
-The aim is to examine the relationship between lumbopelvic rhythm and postural control, daily living activities, and quality of life.

Hypotheses;

H1: Lumbopelvic rhythm differs in individuals with AIS compared to healthy individuals.
H2: Lumbopelvic rhythm in individuals with AIS It is related to the localization, type, and severity of the curvature.
H3: In individuals with AIS, lumbopelvic rhythm is associated with postural control.
H4: In individuals with AIS, the lumbopelvic rhythm differs in terms of curvature localization, type, and severity during sitting, standing, and walking.
H5: Lumbopelvic rhythm is related to quality of life in individuals with AIS.

3. Research Materials and Methods

3.1. Location of the Research

Hacettepe University, Faculty of Physical Therapy and Rehabilitation, Movement Analysis Laboratory

3.2 . Timing of the Research

The study begins on May 15, 2025, and ends on November 15, 2026.

3.3. Characteristics of Individuals to be Included in the Study and Sample Size Calculation

The study group will consist of individuals diagnosed with AIS who apply to the Faculty of Physical Therapy and Rehabilitation at Hacettepe University. Participants in the healthy group will be selected using a snowball method from among the relatives of patients or researchers who apply to the Faculty of Physical Therapy and Rehabilitation. The number of individuals to be included in the study will be determined by a power analysis after analyzing the data of 10 individuals diagnosed with AIS and 10 healthy individuals who meet the inclusion criteria.

AIS group inclusion criteria:
Those diagnosed with AIS,
Between the ages of 10 and 18,
Having a Cobb angle greater than 10°,
Pain intensity < 3
Volunteer individuals

Exclusion Criteria:
Male gender,
Body mass index ≥30,
The presence of additional pathologies affecting the lumbopelvic region (disc herniation, spondylolisthesis, hip dysplasia, rheumatic diseases, etc.),
Chronic pain lasting longer than 3 months,
Lower extremity length difference > 2 cm
Orthopedic or neurological problems affecting the lower or upper extremities.
A history of acute injury,
History of spinal surgery,
Individuals with vestibular pathology or severe balance disorders

Control Group Inclusion Criteria:
Those who have no diagnosed or known illness,
Between the ages of 10-18
Has similar demographic characteristics to the AIS Group.
Volunteer individuals

Exclusion Criteria:
Male gender,
Body mass index ≥30
Individuals with acute injury or pain will be excluded from the study.

3.4. Type of Research (Place an 'X' in the relevant column)

Cross-sectional		X	
Case Studies			
Cohort Studies	**Retrospective**		
	Prospective		
Qualitative			
Other (write in place of the cross)			

3.5 . Research Methodology

Data collection will be carried out at the Movement Analysis Laboratory of the Faculty of Physical Therapy and Rehabilitation, Hacettepe University.

Participants' demographic data such as gender, age, height, and weight, as well as age at scoliosis diagnosis, age at menarche, and treatment processes, will be collected through individual self-reporting using a structured questionnaire specifically designed for this study. The questionnaire will be explained to each participant before the research process begins, and after obtaining the necessary consent, it will be completed through face-to-face interviews. The data provided by the participants will be used only for research purposes in accordance with confidentiality principles, and data security will be ensured. All data obtained during the study process will be analyzed only by the research team.

Curve pattern information obtained from the individuals' existing anteroposterior radiographic images will be recorded along with the spinal region (cervical, thoracic, lumbar) and the measured Cobb angle degrees. Axial trunk rotations will be measured with a scoliometer and added to the form. The severity of the patients' curvature will be evaluated using the Cobb angle method, which SOSORT and SRS consider a primary outcome of treatment and accept as a standard for measuring deformity in scoliosis. Measurements will be taken using data from the patient's existing anteroposterior radiographic image. The Cobb angle is defined as the angle between a line drawn from the upper edge of the upper vertebra with the greatest curvature and a line drawn from the lower plate of the lower vertebra with the greatest curvature. This will be measured using a computer program and recorded in degrees on the form. According to the SRS classification, the curve pattern is determined by the location of the apex. The primary curve apex is between the 2nd thoracic vertebra and the 11th-12th thoracic vertebrae. Individuals with curves in the intervertebral disc space are classified as thoracic, those between the 12th thoracic vertebra and the 1st lumbar vertebra are classified as thoracolumbar, those between the 1st-2nd lumbar intervertebral disc and the 4th lumbar vertebra are classified as lumbar, and curves in both the thoracic and lumbar regions are classified as double curves (19). In our study, the curves will be named according to this classification and recorded in the form.
included in the study will be performed using an Inertial Measurement Unit (IMU). Data will be collected using Movella DOT wearable sensors (Movella Inc. , Henderson, NV, USA) at a sampling rate of 60 Hz. IMU sensors will be placed at C7, the thoracolumbar junction, the lumbosacral junction, and the lateral midpoints of both thighs, and secured to the skin with a flexible band. This placement will allow for the acquisition of lumbar and hip movements. The device will be calibrated before measurements begin for each participant . The device's zero point will be determined while participants stand upright barefoot. Participants will be asked to follow a standardized movement protocol. This protocol includes: maximum trunk flexion by leaning forward while standing, maximum trunk extension by leaning backward while standing, maximum right and left trunk rotation while standing, and right and left lateral trunk flexion while standing, as well as standing up and walking. Participants will be asked to repeat each movement 3 times, and the average of the data will be taken (11,12). The movement patterns of the lumbopelvic region will be analyzed using raw data on acceleration and angular velocity obtained from the IMU device .
Postural control will be assessed using the Bertec Balance Check Screener™ strength platform (BP5050 Bertec Co. , Columbus, OH, USA) (13). The participant will be positioned on the platform with their feet parallel to each other and the distance between their feet being half shoulder width (14). In a static stance, the participant will be asked to remain as still as possible on hard and soft surfaces with their eyes open and closed, and the amount of anterior-posterior and right-left postural sway will be determined. Participants will be asked to move forward, backward, right, and left as far as they can on a hard surface with their eyes open and their feet in the same position, without breaking contact between their feet and the platform, and the amount of displacement of the center of gravity forward,

backward, right, and left (stability limits) will be recorded in cm (15,16). Each measurement will be performed 3 times, and the 3rd measurement will be used in the analysis (17).To assess quality of life, the Scoliosis Research Society's Health-Related Quality of Life-22 (SRS-22) questionnaire will be used. The SRS-22 questionnaire is a quality of life scale specific to scoliosis. The SRS-22 is a 22-question scale with a 5-point Likert scale, divided into five subgroups: pain, general appearance/image, spinal function, mental health, and treatment satisfaction. Each question has responses ranging from negative to positive. The most negative response is worth 1, and the most positive is worth 5. The scores from each section are added together and divided by the number of questions answered to obtain the scores for the subgroups and the total score. The lowest possible score is 1, and the highest is 5. A higher score on the scale indicates improved quality of life, while a lower score indicates a lower quality of life. This shows that it has decreased. The validity and reliability study of the Turkish version of the questionnaire, which has been shown to be valid and reliable in many languages, was carried out by Alanay et al. in 2005 (19).

Pain assessment will be performed using a visual analog scale (VAS). Participants will indicate the intensity of their pain on a scale of 0 to 10 , where 0 represents no pain and 10 represents unbearable pain.

A project application will be submitted to the TÜBİTAK 1002-A Rapid Support Program for the procurement of the Movella DOT wearable sensors to be used in this study.

3.6. Statistical Analysis of the Research

Descriptive statistics will be used for participants' demographic and clinical characteristics (age, gender, type of scoliosis, Cobb angle, etc.). The study results will be analyzed using the “Statistical Package for Social Sciences” (SPSS) Version 16.0 statistical program. Standard deviation, mean, minimum, and maximum values will be calculated. A 95% confidence interval will be used to evaluate the reliability of the analysis results. The normality of the distribution of variables will be examined using Kolmogorov-Smirnov/Shapiro-Wilk tests and histogram graphs. For comparisons of lumbopelvic rhythm and postural control between the scoliosis and control groups, an independent samples t-test will be used if the data show a normal distribution, and the Mann-Whitney U test will be used if the data do not show a normal distribution. Pearson correlation analyses will be performed for normally distributed data and Spearman correlation analyses for non-normally distributed data to examine the relationships between lumbopelvic rhythm, postural control, pain level, and quality of life in the AIS group. The significance level will be considered to be $p<0.05$.