Analysis of Correlation between Spinal Deformation and Pelvic Asymmetry in High School Girls with Idiopathic Scoliosis

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Dear Editor-in-Chief

Scoliosis is defined as a spinal deformity that is accompanied by rotation of the spine and is characterized by a lateral curvature of >10 degrees (1, 2). In particular, adolescent idiopathic scoliosis (AIS) of unknown cause is a common spinal deformity with a prevalence of 0.47%-5.2% (3). Such AIS has a higher prevalence in adolescents aged 15 years or older (after puberty) and is more frequent in female adolescents than males as the age increases (3). AIS can induce not only spinal deformity but also pelvic asymmetry (4), and the pelvic asymmetry accompanying spinal deformity can lead to menstrual pain (5), back pain due to adulthood pregnancy, and higher rates of infertility in girls (6). Therefore, analysis of AIS in female students aged 15 years or older requires a comprehensive study that includes not only spinal deformity but also pelvic asymmetry variables. In this regard, we aimed to help develop a complex exercise program for improving AIS and pelvic asymmetry in female adolescents by analyzing the correlation between spinal deformity and pelvic asymmetry variables in high school girls with AIS.

For this study, 126 high school girls in Incheon, South Korea, in 2020 (13.50±2.78 degrees, 16.58±0.89 year, 161.61±4.99 cm, 60.55±10.67 kg) had orthopedic findings of AIS.

Participants read and signed an informed consent form approved by the Institutional Review Board of Incheon National University prior to starting the testing.

For three-dimensional measurements of the spine and pelvis, surface tomography was performed using a raster stereoscopic imaging method using a spinal structure analyzer (Formetric 4D, DIERS International GmbH, Germany). For accurate measurements, the underwear and top were removed so that the three landmarks, C7, and both posterior superior iliac spines could be seen. This method measures the body surface contour through the halogen lamp, so it is non-invasive, has no risk of radiation exposure, and enables fast and accurate measurements. All measured data, the mean and standard deviation were calculated using the SPSS 25.0 (IBM Corp., Armonk, NY, USA). The correlation between the spine and pelvic variables was analyzed through Pearson correlation, and the significance level was set to $P< .05$ (Table 1).

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Table 1: Correlation between spine and pelvic variables

Variables	Mean±SD	1	2	3	4	5	6	7
Scoliosis	14.70±4.20	1						
Lordosis	39.78±8.86	-.022	1					
Kyphosis	46.87±10.01	.011	.527**	1				
Pelvic oblique	-0.24±3.07	-.186*	-.101	-.077	1			
Pelvic torsion	0.19±2.39	-.052	-.002	.090	-.258**	1		
Pelvic inclination	22.50±5.38	-.219*	.402**	-.142	.014	-.223*	1	
Pelvic rotation	-0.19±3.77	.057	-.144	-.156	-.134	-.101	-.042	1

*: $P<.05$, **: $P<.01$, The units of all variables are degrees.

Because of the correlation analysis, significant correlations were found between the scoliosis angle, pelvic oblique ($P= .037$), and tilt ($P= .014$). Especially, pelvic inclination is associated with the severity of scoliosis progression (7). In the case of lumbar lordosis, similarly to the previous study, a significant correlation was found with the pelvic inclination (8). Interestingly, there was a correlation between the scoliosis angle and the pelvic oblique in mild AIS, unlike previous study that showed no relation between the angle of scoliosis at mile level and frontal pelvic alignment (9). These results confirm that pelvic asymmetry appears even in mild AIS of less than 20 degrees, suggesting that complex considerations of spinal deformity and pelvic asymmetry is necessary in the prevention and improvement of AIS in women after puberty. Developing and applying an exercise program considering the spine and pelvis will help to improve scoliosis and pelvic asymmetry, as well as prevent various problems in adulthood induced by AIS.

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Conflict of interest

The author declares that there is no conflict of interest.

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