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The Trunk-Pelvis-Hip Angle Test is a Reliable Measurement of the Range of the Lower Trunk-Pelvis Rotation in Adolescents

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Abstract

Introduction: Rotational movements of the trunk and pelvis are visible during activities of daily living. To date, no researchers have assessed the reliability of any test used to examine rotational mobility of the lower trunk-pelvis complex. The aim of the study was to assess the reliability of the Trunk-Pelvis-Hip Angle test.

Materials and Methods: The study included healthy 41 adolescents aged 12-15. Measurements were performed by three experienced physiotherapists.

Results: Reliability was excellent for three observers. Intraclass correlation coefficient ranged from 0.894 to 0.938 for intraobserver reliability. The interobserver intraclass correlation coefficient ranged from 0.888 to 0.900.

Conclusion: The Trunk-Pelvis-Hip Angle test is a reliable measurement and may be used for examining the range of the lower trunk-pelvis rotation in adolescents. The test provides a new possibility in diagnosing the musculoskeletal system.

Keywords: Adolescents; Pelvis; Range of Rotation; Reliability; Spine; Trunk

Abbreviations

TPHA test	:	Trunk-Pelvis-Hip Angle test
TPHA left	:	Trunk-Pelvis-Hip Angle test on the left side of the body
TPHA right	:	Trunk-Pelvis-Hip Angle test on the right side of the body

Introduction

Rotational movements of the trunk and pelvis are visible during activities of daily living, walking and running [1-3]. Dysfunctions and deformities of the musculoskeletal system can lead to the limitation of rotation. Limitations of the range of rotational mobility of the spine were noted, inter alia, in individuals with low back pain syndrome [4-6] and in adolescents with scoliosis [7-9]. Assessment of the range of motion is one of fundamental aspects of physiotherapy that is necessary to plan appropriate interventions. Ranges of rotational movements of the spine have been measured with the use of a goniometer or inclinometer [10-13]. In the past, the reliability of several tests assessing the range of thoracic rotation in adults [12,13] and adolescents [14] was examined. To date, no researchers have assessed the reliability of any test used to examine rotational mobility of the lower trunk-pelvis complex. In previous studies, the Trunk-Pelvis-Hip Angle test (TPHA) was used to measure the range of lower trunk-pelvis rotation in girls with idiopathic scoliosis and in able-bodied girls. A high level of repeatability of measurements performed by one researcher has been confirmed [9] but the interobserver reliability of the test has not been demonstrated so far. The aim of the study was to assess the reliability of the TPHA test in healthy adolescents.

Materials and Methods

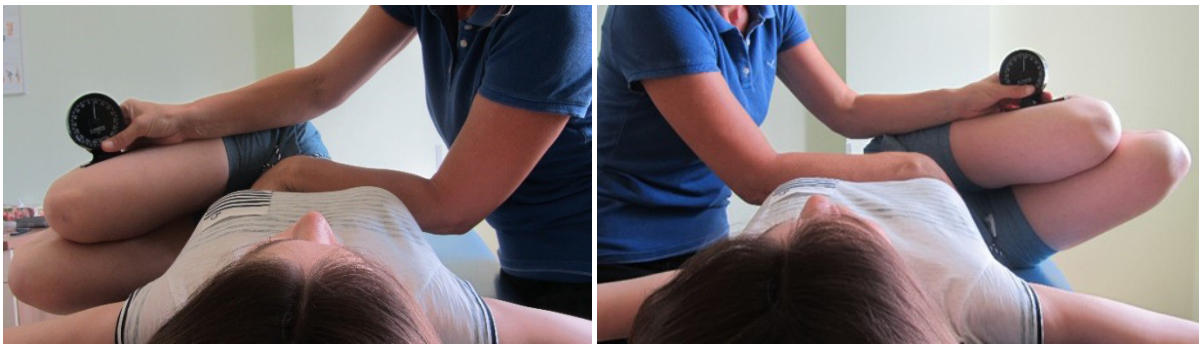
The study included healthy 41 participants, 26 girls and 15 boys (Table 1). Adolescents aged 12-15 with the angle of trunk rotation below 5° were qualified for the study. Disorders of the

nervous or muscular system, back pain, injuries within the last 12 months prior to the study and an angle of trunk rotation at the level of 5° or more were considered as exclusion criteria. Parents of all the participants signed the consent form to take part in the study. The study was approved by the Senate Research Ethics Committee of Józef Piłsudski University of Physical Education in Warsaw (SKE 01-23/2017).

Gender	Age (years) ±SD	Weight (kg) ±SD	Height (cm) ±SD	BMI ±SD
Females	12.0 ± 0.7	44.2 ± 7.1	157.3 ± 7.4	17.8 ± 1.9
Males	14.7 ± 0.8	61.7 ± 16.1	169.7 ± 6.6	21.2 ± 4.6

Table 1: Gender, age, weight, height and BMI of the study group - mean values and standard deviation.

The research was carried out during body posture screening tests in the lower - secondary school. Measurements were performed by three experienced physiotherapists. TPHA test [9] conducted with the use of a Rippstein's plurimeter (Rippstein, Switzerland) was applied to measure the range of the lower trunk-pelvis rotation (Figure 1). Prior to the study, the physiotherapists had undergone training regarding the performance of TPHA test.



(A) **(B)**

Figure 1: Trunk-Pelvis-Hip Angle (TPHA) test: **(A):** The lower trunk-pelvis rotation to the left; **(B):** The lower trunk-pelvis rotation to the right. Limitation of the lower trunk-pelvis rotation to the right.

Physiotherapists performed the test independently, twice in each of the study participants in two separate rounds with about 20-30-minute intervals. They were blinded to their previous measurements and the measurements of the other two examiners. Statistical analysis was performed with the use of ANOVA Intraclass and Interclass Correlation Coefficient (ICC) for dependent groups, IBM SPSS Statistics version 20. The repeatability of the two measurements performed by each therapist was evaluated. In addition, the results of the measurements obtained by each of the three therapists were analysed. The following criteria were taken into account: the coefficient value lower than 0.40 - poor reliability, between 0.40 and 0.59 - fair reliability, between 0.60 and 0.74 - good reliability, between 0.75 and 1.00 - excellent reliability [15].

Results

Both the intraobserver and interobserver ICC were excellent in two sets for 3 observers. The intraobserver reliability was 0.894 - 0.938 and the interobserver reliability was 0.888 - 0.900 for the TPHA test (Table 2).

Test	Intraobserver reliability			Interobserver reliability	
	Observer	ICC	95% confidence interval	ICC	95% confidence interval
TPHA left	Observer 1	0.894	0.810-0.942	0.9	0.840-0.942
	Observer 2	0.895	0.812-0.943		
	Observer 3	0.937	0.884-0.966		
TPHA right	Observer 1	0.938	0.887-0.966	0.888	0.821-0.934
	Observer 2	0.914	0.845-0.953		
	Observer 3	0.914	0.845-0.953		

Table 2: Intraobserver and interobserver reliability of the Trunk-Pelvis-Hip Angle test (TPHA left -Trunk-Pelvis-Hip Angle test to the left; TPHA right -Trunk-Pelvis-Hip Angle test to the right; ICC- intraclass correlation coefficient).

(Table 3) presents mean values of the Trunk-Pelvis-Hip Angle test on the left and right side of the body for each of the three observers and a mean value of the measurements made by the three observers.

Test	Mean values for each observer			Mean values for three observers	
	Observer	Female	Male	Female	Male
TPHA left (°) ±SD	Observer 1	−10.8 ± 4.0	−2.1 ± 9.1	−9.1 ± 4.1	−2.3 ± 8.0
	Observer 2	−9.4 ± 4.3	−1.7 ± 8.5		
	Observer 3	−7.0 ± 4.0	−3.1 ± 6.3		
TPHA right (°) ±SD	Observer 1	−7.0 ± 5.0	3.1 ± 9.0	−6.8 ± 4.6	2.8 ± 8.3
	Observer 2	−6.2 ± 4.8	2.0 ± 9.6		
	Observer 3	−7.2 ± 4.0	3.1 ± 6.3		

Table 3: Mean values of Trunk-Pelvis-Hip Angle test (TPHA left -values of Trunk-Pelvis-Hip Angle test to the left; TPHA right -values of Trunk-Pelvis-Hip Angle test to the right).

Discussion

The main finding of the study was that the Trunk-Pelvis-Hip Angle test provides reliable results in able-bodied adolescents. Both intraobserver and interobserver reliability results were excellent with ICC >0.8. No previous studies have shown reliable testing of lower trunk-pelvis rotation in healthy adolescents. Stępień, et al. only confirmed the repeatability of the TPHA test performed by one researcher in the groups of girls with and without idiopathic scoliosis [9]. Our present study revealed intraobserver and interobserver reliability of the TPHA test performed by three independent physiotherapists. To date, the reliability of tests assessing spinal rotation has been evaluated in the group of young adults [12,13]. Iveson et al. examined the reliability of the Sidelying Thoracic Rotation Measurement (STRM) in 30 subjects, and then they used the test to assess the ranges of rotation in 156 young women and men with various musculoskeletal conditions. Excellent reliability of the applied test was revealed [12]. Our research also revealed differences between the left-side and right-side rotation of lower trunk-pelvis complex in healthy adolescents. However, it is difficult to compare these results due to the differences between the groups participating in the studies.

Johnson et al. assessed the reliability of the measurements of rotational movements of the thoracic spine in 5 different positions performed on 46 healthy adult volunteers. The values of rotation measurements were related to the body position during the measurement. Good reliability was noted in all the techniques [13]. Feijen, et al. evaluated the reliability of the "lumbar-locked rotation test" for thoracic spine rotation in 21 adolescent swimmers. They revealed good to excellent reliability of the test [14]. All mentioned authors measured the rotation of the upper trunk in adults. The TPHA test was applied to measure the ranges of lower trunk-pelvis rotation. During the TPHA test, the chest was stabilised and lower trunk measurements were made, while in other studies a lower part of the body was stabilised and the rotation was performed by an upper part of the trunk. Due to these differences in methodology, the obtained values cannot be compared with the results obtained by other researchers.

In our opinion, examining lower trunk-pelvis rotation is very important due to the fact that these movements are repeated many times in everyday life, e.g. during gait. The measurement of rotation in the growth period is also significant taking into account the preexistent physiological rotational asymmetry of vertebrae in children [16-18]. The asymmetry of spinal rotation was also observed in healthy adolescents [9,19]. The disturbed rotational pattern is perceived as one of the factors contributing to the development of scoliosis [20,21]. The research carried out in the past revealed that the ranges of trunk and pelvis rotation in girls with idiopathic scoliosis are lower than in the case of girls without scoliosis, while the range of rotation decreases together with an increase in spinal curvature [7-9]. Perhaps early detection of significant differences between the ranges of rotation in children will make it possible to implement derotational therapeutic interventions which will reduce the risk of scoliosis. However, this issue needs further research.

Conclusion

The TPHA test is a reliable measurement and may be used for examining the range of the lower trunk-pelvis rotation in adolescents. The test provides a new possibility in diagnosing the musculoskeletal system and assessing the effectiveness of physiotherapy.

Conflict of Interest

No economic interest or conflict of interest.

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