World Journal of Sport Sciences 7 (1): 54-56, 2012
ISSN 2078-4724

DOI: 10.5829/idosi.wjss.2012.7.1.64109

Correlation Between Height, Weight, BMI with Standing Thoracic and Lumbar Curvature in Growth Ages

[1]*Amin Allah Taheri Tizabi*, [1]*Reza Mahdavinejad*, [1]*Ali Azizi*,
[2]*Teymour Jafarnejadgero and* [1]*Mostafa Sanjari*

[1]Faculty of Physical Education and Sport Science, Isfahan University, Isfahan, Iran
[2]Department of Physical Education and Sport Science, Bu Ali Sina University, Hamadan, Iran

Abstract: The aim of the present study was to investigate correlation between height, weight, body mass index (BMI)with standing thoracic and lumbar curvature in growth ages.In this study, 636 healthy boys between consecutive age-groups (12-13-14-15-16-17 ages) were participated. The age, height in upright position with a tape measure and the weight of all children were recorded. Their BMI was also estimated (BMI= weight (kg) /heght^2 (m)). The magnitude of Thoracic kyphosis and the lumbar lordosis was estimated from the spinous processes of T_1-T_{12} for measurement of thoracic kyphosis and T_{12}-S_2 for measurement of lumbar lordosis. The sagittal curves were measured with a flexible ruler -a non-invasive device-with the child standing in a relaxed position. The accuracy and the reliability of this technique are studied and shown to be acceptable.*Result:* Pearson correlation coefficient was used to calculate relationship between different factors. Pearson test revealed that there was significant correlation between kyphosis with lordosis, height and weight (P<0.01) and so significant correlation was seen between lordosis with BMI and weight (P<0.01). *In conclusion,* this study showed significant correlation between kyphosis with lordosis, height and weight.

Key words: Age % Height % Weight % BMI % Thoracic Kyphosis And Lumbar Lordosis

INTRODUCTION

The analysis of the changes of spinal curvature and anthropometrical properties, especially in children and adolescents, is very important because is affected by complex interaction between anatomical, muscular, psychological factors and this changes take place very fast. For example some studies reported that annual spinal growth is about 15 mm per year at age 11 year and about 5 mm per year at age 16 years [1, 2]. About spinal curvature changes to rule indicated that thoracic kyphosis and lumbar lordosis increase almost 6 degree during peak growth period [1, 2].

After birth, as is the case for other skeletal parameters in children, changes in the spinal sagittal curves also occur during the growth period [3]. Despite the importance of recognizing the changes that accrue on spinal curvature and anthropometrical properties according to age, few studies have analysed these variables (height, weight, BMI, thoracic and lumbar curvature) in homogeneous sample populations during growth. In this study we focused on the development of spinal posture and anthropometrical properties before, during and after peak growth period and find relationship between them. Measurement of these curves of spinal column in sagittal plane with X-ray method cannot be used in screening and large population because it would not be safe for children and is not economical. For this purpose a flexible ruler - simple, inexpensive, safe and non-invasive device for measuring the degree of thoracic kyphosis and lumbar lordosis in the standing position - were used.

MATERIALS AND METHODS

Subjects: In this study, 636 normal boys were participated. They were randomly selected from schools and divided to six age groups (12, 13, 14, 15, 16, 17 years). The participants that were investigated had no spinal column surgical history or scoliosis disorder.

Corresponding Author: Amin Allah Taheri Tizabi, Faculty of Physical Education and Sport Science, Isfahan University, Isfahan, Iran. Postal cod: 8174673441.
Tel: +983117932577, Fax: +983117932577.

Measurement: Height in upright position with a tape measure and the weight of all children were recorded. Their body mass index was also estimated (BMI= weight (kg) /height^2 (m)).

The sagittal plane of the growing spine was studied by flexible ruler. This instrument is described as a 40, 50 or 60 cm strip that covered with plastic, which can be bent in one plane only and retains the shape into which it is bent [4]. Therefore, it can be used to copy any curved surface. Flexible ruler (flexi curve) was used to measure the degree of spinal curves that can be placed the spinal column to measure curves in the sagittal plane. The flexible ruler provides a quick, inexpensive and non-invasive way to assess posture in clinical, community or large population. Several investigators have established the validity of flexible ruler postural measures by correlating them with measures of kyphosis and lumbar lordosis taken from spinal radiographs and other instruments, such as goniometers, kyphometers and inclinometers [5-11]. This device is widely used to measure the degree of spinal curvature in the sagittal plane such as kyphosis and lumbar lordosis in physiotherapy and sport medicine field [7].

Procedure: For the spinal measurements, the flexible ruler is placed on the mid-line of the spine between two marked points (T_1, T_{12} vertebrae for measurement of kyphosis and T_{12}, S_2 vertebrae for measurement of lordosis) [5, 12]. The measurement was performed with the subject standing in their usual relaxed posture then flexible ruler was placed over the spinous processes of T_1 - T_{12} for measurement of thoracic kyphosis and T_{12}-S_2 for measurement of lumbar lordosis spine and shaped as spinal curves. The instrument was carefully removed and placed on a piece of plain white paper then the spinal curvature copied by a pencil along the flexible ruler and a vertical line was drawn to connect the T_1 to T_{12} and T_{12} to S2 landmarks.Then by using the equation of 2 =4Arctang 2H/L the degree of lumbar lordosis and thoracic kyphosis calculated. In this equation L is the straight line from the T_1 to T_{12} and T_{12} to S_2 vertebrae which was marked by the tester and the H is the distance between the deepest point of the lumbar curve and L line.

RESULTS

Table 1 shows that there was significant correlation between kyphosis with lordosis, weight and height (P<0.01), but there was no significant correlation between kyphosis and BMI (P>001). Also, there was significant correlation between lordosis with weight and BMI (P<0.01), but there was no significant correlation between lordosis and height.

Table 1: Correlation between thoracic kyphosis lumbar lordosis, weight, height and BMI

Correlation		Kyphosis	Weight	Height	Bmi
Kyphosis	Pearson Correlation	1	.109*	.109*	.095
	Sig. (2-tailed)		.006	.006	.016
	N	636	636	636	636
Lordosis	Pearson Correlation	.135*	.152*	-.094	.210*
	Sig. (2-tailed)	.001	.000	.017	.000
	N	636	636	636	636

*. Correlation is significant at the 0.01 level (2-tailed)

DISCUSSION

The aim of the present study was to investigate correlation between height, weight, BMI with standing thoracic and lumbar curvature in growth ages. Correlations between height, weight and BMI with spinal curvature (thoracic kyphosis and lumbar lordosis) were investigated in this study. The result indicated that there is significant correlation between height, weight and BMI with kyphosis. Korovessis *et al.* (2004) showed that there is significant correlation between BMI and spinal curvature; this study showed that thoracic kyphosis has negative correlation with BMI [13]. Legaye and Duval-Beaupere [14] showed a strong correlation between pelvic tilt angle and thoracic kyphosis and lumbar lordosis, these authors concluded that the pelvic angle, the sacral angle and the pelvic balance may directly affect thoracic kyphosis and lumbar lordosis. Our result also showed that thoracic kyphosis is correlated with lumbar lordosis. Hoseinifar *et al.* [15] reported that thoracic kyphosis was not correlate with BMI, but they found significant correlation between BMI and lumbar lordosis [16]. Tuzan *et al*. [16] demonstrated increase of lumbar lordosis and sacral inclination with BMI. They found that lumbar lordosis was increased with high amount of BMI, so there is association between BMI and lumbar lordosis [17]. Other study also indicated correlation between BMI and lumbar lordosis [18, 19]. Ng *et al.* [19] found that there isn’t significant correlation between lumbar lordosis and BMI in both health and individual with low back pain [19-21]. Different findings of above studies may be related to some difference in population, age, tools of measurement and design of study.

ACKNOWLEDGEMENTS

The authors wish to thank the all subjects who participated at this study.

REFERENCES

1. Nicolopouios, K.S., R.G. Burwell and J.K. Webb, 1985. Stature and its component in healthy children, sexual dimorphism and age related changes. J. Anat., 141: 105-14.
2. Stokes, I.A. and L. Windisch, 2006. Vertebral height growth predominant over intervertebral disc height growth in the adolescent spine. J. Spine, 31(14): 1600-4.
3. Voutsinas, S.A. and G.D. MacEwen, 1986. Sagittal profiles of the spine. Clin Orthop Rel. Res., 210: 35-242.
4. Fon, G.T. and M.J. Pitt, 1980. Thies AC Jr. Thoracic kyphosis: range in normal subjects. AJR Am. J. Roentgenol., 134: 979-983.
5. Burton, A.K., 1986. Regional lumbar sagittal mobility measurement by flexicurves. Clin. Biomec, 1: 20-26.
6. Milne, J.S. and J. Williamson, 1983. A longitudinal study of kyphosis in older people. Ageing, 12(3): 225-233.
7. Milne, J.S. and J. Lauder, 1976. the relationship of kyphosis to the shape of vertebral bodies. Ann. Hum. Biol., 3: 173-179.
8. Nissinen, M., M. Heliovaara, K. Tallroth and M. Poussa, 1989. Trunk asymmetry and scoliosis. Anthropometric measure ments in prepubertal school children. Acta Paediatr Scand. 78: 747-753.
9. Nissinen, M., M. Heliovaara, M. Ylikoski, Poussa and M. Turnk, 1993. Asymmetry and screening for scoliosis: a longitudinal cohort study of pubertal schoolchildren. Acta Paediatr Scand. 82: 77-82.
10. Nourbakhsh, M.R., S.J. Mousavi and M. Salavati, 2001. Effects of lifestyle and work-related physicalactivity on the degree of lumbar lordosis and chronic low back pain in a Middle East population. J. Spinal Disord. 14: 283-292.
11. Simpson, S.R.,1989.Evaluation of a flexible ruler technique for measuring lumbar lordosis in the clinical assessment of low back pain. J. Soc. Occup. Med., 39(1): 25-29.
12. Hart, D.L. and S.J. Rose, 1986. Reliability of a non-invasive method for measuring the lumbar curve. J of Orthop. Sports Phys. Ther., 8: 180-184.
13. Korovessis, P.G., G. Koureas, Z. Papazisis, 2004. Corelation between backpack weight and way of carring sagittal and frontal spinal curvature, athletic, activity and dorsal and low back pain in schoolchilderen and adolescents. J Spinal Disord Tech., 17(1): 33-40.
14. Legaye, J. and G. Duval-Beaupere, 2005. Sagittal plane alignment of the spine and gravity: a radiological and clinical evaluation. Acta Orthop Belg., 71: 213-220.
15. Hoseinifar, M., F. Ghiasi and A. Akbari, 2007. The Relationship between Lumbar and Thoracic Curves with Body Mass Index and Low Back Pain in Students of Zahedan University of Medical Sciences. Journal of Medical Sciences. 7(6): 984-990.
16. Tuzan, C., Yorulmaz, A. Cindas and S. Vatan, 1999. Low back pain and posture. Clin. Rheumatol., 18: 308-312.
17. Ahey, M., M. Akbari and N. Salsabili, 1997. The survey of lumbar curve in love back pain and healthy subject. Nabz., 7: 8-35.
18. Kamali, N., M. Hadji Ahmadi, M. Kashni and A. Mahbobi, 2004. The effect of gender and obesity on lumbar lordosis. J. Med. Sci., 6: 38-39.
19. Ng Jk, C.A., Richadston, V. Kippers and M. Parnianpour, 2002. Comparison of lumbar range of movement and matched controls. J. Rehabili Med., 34(3): 109-13.
20. Taheritizabi, A., R. Mahdavinejad, A. Azizi, T. Jafarnejadgero and M. Sanjari, 2012. Investigation of Sagittal Curves of Spinal Column and Establishing the Norm of Thoracic Kyphosis and Lumbar Lordosis. World Journal of Sport Sciences, 6(1): 80-83.
21. Rajabi, F. Seidi and F. Mohamadi, 2008. Which Method Is Accurate When Using the Flexible Ruler to Measure the Lumbar Curvature Angle? Deep Pint or mid Point of Arch? World Applied Sciences Journal, 4(6): 849-852.