



Growth Pattern of Posture in School Children From Age Group of 4 To 14 Years: an Observational Study

KEYWORDS

School children, Posture, Growth patterns, Posture spinal variations

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ABSTRACT Body Posture is intentionally or habitually assumed position in space by an individual. Neutral posture is a resting position of all body joints and soft tissues in least tension. Various Postural variations cause undue tension or lengthening of muscles, affecting their strength and endurance. Present study was an on-field study on 135 children between 4-14 years of age to determine the relation of age and various postural variations. Participants were divided into 5 groups according to age, and their weight and heights measured. Posture was observed using a plumb line in sagittal and frontal planes. Results showed a significant relation of age with development of posture patterns. It was concluded that there is a need for maintenance of normal posture from early years of life, taking conscious efforts and compulsory education in children about the relative importance of having good posture for betterment of life and health.

INTRODUCTION:

Posture is a state in which an individual holds his body in an upright position against the gravity [1]. A good posture refers to a position in which spinal curvatures lie in neutral position and all other joints in upper and lower limbs are in alignment[2]. Maintaining an ideal posture while sitting, standing, lying or walking is very important to maintain health and fitness of mind and body. Various studies show that poor posture leads to various musculoskeletal pains and deformities, and may also alter mood, leading to depression [3, 4]. Good Posture helps decrease the abnormal wearing of joint surfaces and decreases stress on ligaments, preventing undue fatigue [5]. Body posture is influenced by many factors including musculoskeletal alignment, muscle strength, body endurance, fatigue, general health, state of mind, occupation, age, weight, height, etc [6]. Studies have been conducted to model some of these factors to establish the interrelation between the two [6-7]. However, postures generated by human body are difficult to simulate since the body is composed of a large number of interrelated muscles which helps in the formation of various postures. Moreover, during growth other than physiological, biochemical, anatomical and morphological, there is skeletal maturity also, which is an important landmark of adolescent growth spurt. Skeletal maturity determines height of an individual, which is influenced by age and sex[8-9]. Although studies show a considerable change in postural attitudes in the elderly due to aging process and subsequent decrease in flexibility strength and power of muscles in body, little work has been done to find influence of age over posture in early years of life[6]. The present study has been conducted to sort out relation of one such factor which might influence posture involvement in humans. The study was conducted on school children to analyze the hypothesis that age has a significant impact on growth pattern and posture, with the aim of examining evolution of upright, static, sagittal posture in children between age group 4-14 years to identify possible critical phases of postural evolution. Results of this study establish the importance of maintaining normal posture right from early years of life.

METHODOLOGY

Chronological age of all participants (67 boys, 68 girls) in years, months and days was calculated from their date of birth. Following formula was used to calculate the chronological age of all participants: Year Month Day(Test Date) - Year Month Day(Birth Date) = Chronological Age[10]

Subjects were divided into five groups according to their age.

Table I (a): Division of participants into five groups according to their age

n= 135	4-6 years	6-8 years	8-10 years	10-12 years	12-14 years
Age limit in each group	4.0-5.49 years	5.5-7.49 Years	7.5-9.45 Years	9.5-11.45 Years	11.5-13.45 Years
Boys (N)	11	12	15	14	15
Girls (N)	15	13	14	13	13

All participants were weighed with minimal clothing, using a weighing apparatus (precision of 0.1kg). Height of subjects was recorded, without footwear, using a vertically mobile scale (expressed to nearest 0.1cm). BMI was calculated as weight in kilograms, divided by square of height, in meters (kg/m²).

Posture analysis: The posture of all participants was analyzed using a plumb line. Subjects were made to stand in between footprints drawn on portable posture boards, and the plumb line suspended from an overhead bar, with the plumb bob hung in line with the standard base point on the posture board (anterior to lateral malleolus in sagittal view and midway between the heels in back view). The position of body parts and joints in relation to plumb line was observed in Anterior, posterior and lateral views [11].

Statistical analysis

SPSS software (v.16.0, SPSS Inc.) was used for statistical analysis. Descriptive statistics was used to compute vari-

ous morphological variables among boys and girls. One way analysis of variance (ANOVA) and Post hoc analysis was used to find out exact difference of various postural variations and good posture between various age groups. Confidence Interval (CI) was set at 95% for all the statistical analysis.

RESULTS

Characteristics of subjects as mean ± SD for age, body weight, height and BMI of various age groups are shown presented in table I(b). ANOVA for multiple dependent variables by one fixed factor showed highly significant difference between mean age (p value=0.000), body weight (p=0.000), height (p=0.000) and BMI (p=0.003) among different age groups in both boys and girls.

Turkey post hoc test revealed that both weight and height had significantly higher values in the age group of 12-14 years as compare to 4-6 years. The difference between mean weight in corresponding age groups from 6- 8 years to 12-14 years were relatively insignificant (p>0.05). Statistical difference between values of BMI in various age groups was relatively insignificant (p>0.05) except in age group of 4-6 years, revealing that from age of 6 to 14 years, there was no par-

ticular demarcation found in values of BMI.

Table II represents frequency of good and poor posture found among various age groups. There is a statistically significant difference found between age groups as determined by one way ANOVA [f(30.8,78.6)=2.42, p=0.05] among girl students. Turkey post hoc test revealed that percentage of good posture among age group 8-10 years (78.6%) was significantly higher than the age group 10-12 years (30.8%) and 12-14 years (30.8%) in girls. There was no statistically significant difference found in percentage of good and poor posture among various age groups in boys from age group of 4-14 years (p=0.654).

Figure I and Figure II display frequency of various spinal variations found among boys and girls from age group 4-14 years. Each bar represents percentage of spinal variations to compare the occurrence of various spinal variations visually in boys and girls. Results depict that 61.2% of all boys and 50% of all girls had normal posture. Percentage observed for the Scoliosis (1.5%) was least among boys, preceded by military back posture (3.0%) and in girls Percentage observed for the military back posture (1.5%) was least, preceded by Scoliosis (4.4 %).

Table I (b): Characteristics of study subjects Boys (n= 67) and Girls (n=68) presented as mean ± standard deviation.

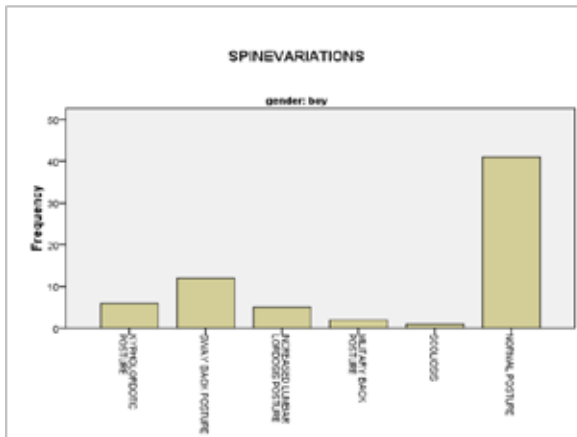
Variables	Gender	4-6 years N= 11 ,15	6-8 years N= 12, 13	8-10 years N= 15, 14	10-12 years N= 14,13	12-14 years N= 15, 13	F value	P value
Age (in years)	Boy	5.18±.87	7.50±.52	9.60±.51	11.43±.51	13.33±.49	385.7	.000
	Girl	5.00± .85	7.46±.52	9.57±.51	11.46±.52	13.38±.51	411.3	.000
Weight (Kgs)	Boy	18.47±3.90	26.42±4.85	32.67±8.21	34.66±7.02	40.31±8.86	17.53	.000
	Girl	16.72±4.37	23.86±4.74	28.84±8.41	35.12±6.89	39.17±9.71	21.9	.000
Height (cm)	Boy	118.18±10.16	129.54±9.98	139.73±5.95	144.79±4.28	156.25±8.69	42.63	.000
	Girl	114.82±17.53	126.49±7.02	136.71±11.43	142.22±9.04	149.33±5.7	20.29	.000
BMI (Kg/ m2)	Boy	13.46±3.32	15.80±2.76	16.95±3.37	16.36±2.71	17.05±2.93	2.81	.003
	Girl	12.73±2.26	15.80±4.47	15.82±3.02	17.02±2.11	17.46±3.16	5.11	.001

N represents the number of boys and girls participants respectively in particular age group.

Table II: Comparison of Frequency of Good and Poor Posture in boys and girls participants between various age groups from 4 to 14 years of age using one way Analysis of Variance

		4-6 years N=11 ,15	6-8 years N=12, 13	8-10 years N= 15, 14	10-12 years N= 14,13	12-14 years N= 15, 13	F value	P value
Boys	Good Posture	54.5	33.3	60	57.1	60	.614	.654
	Poor Posture	45.5	66.7	40	42.9	40		
Girls	Good Posture	60	53.8	78.6	30.8	30.8	2.42	.053
	Poor Posture	40	46.2	21.4	69.2	69.2		

Figure I: COMPARISON OF VARIOUS SPINAL VARIATIONS AMONG BOY STUDENTS FROM AGE GROUP 4-14 YEARS



DISCUSSION

Body posture of an individual outlines position and function of muscles in human body. Poor posture comes from weak muscles and studies show that poor posture has been linked with back, neck and other musculoskeletal pains. Present study has been conducted to find out influence of age on posture evolution and changes occurring in various postural patterns in children as they grow in age.

Overall analysis of posture confirmed that 75% of participants had normal posture while 25% were found to have deviations from normal posture. Slight deviations found among various age groups is considered to be normal in children, which fall under developmental deviations (which disappear with age, with no need to take any measures) [12-13]. Deviations found among children said to be abnormal or poorly held postures are mainly out of habit or poor functioning of muscles. Other causes may be of skeletal origin as the deformity may be in bony regions.

Steps had been taken to outline those variations which are considered normal for a particular age group and only variations of significant impact in later life were added as variations in posture found among various age groups.

Posture Patterns In Age Group 4-6 Years

Average heights and weights as shown in table 1(b) were 118.18±10.16cm and 18.47±3.90kg respectively in boys and 114.82±17.53cm and 16.72±4.37kg respectively in girls. Height and weight showed minor differences between boys and girls, which correlate to the studies of Malina et al (1991) [14]. Commonly found variations considered normal for this age group are hyperextended knees, knock knees, bow legs, protruded abdomen, reduced or less developed longitudinal arch,[12-13] and were not considered. Percentage of boys and girls having normal posture was 63.6% and 53.3% respectively as shown in Table II. Highest percentage of postural variation in boys was sway back posture (27.3%) and in girls was increased lumbar lordosis (20.0%). These variations could also be due to the imbalance of strength of anterior and posterior muscles of trunk and neck which otherwise is normal in this age group. However marked deviation from the plumb alignment supports the need of inducing therapeutic exercise regime to maintain correct body alignment in later stages of life[12-13].

Posture Patterns In Age Group 6-8 Years

Average weights and heights in this group were 26.42±4.85kg and 129.54±9.98cm in boys and 23.86±4.74kg and 126.49±7.02cm in girls as shown in table 1(b). Although there was an increase in body weight and height in this age group as compared to the age group of 4-6 years, statistical analysis showed no significant difference between weight and height of both the groups, which is in accordance with the study of Malina et al (1991)[14]. Variations considered normal for this age group are less developed longitudinal arch, protruding abdomen, prominent shoulder blades, deviation of upper back. Knock knees is almost nonexistent by the age of 6-7 years[12-13], and was not observed in this age group. The percentage of participants having normal posture was 58.3% (boys) and 61.5% (girls). Other spinal postural variations in boys were limited to 8.3% each. Highest percentage of postural variation in girls was sway back and scoliosis (15.4%). Occurrence of scoliosis may be congenital or acquired, for which a careful examination should be undertaken for its management in early years of life[15].

Posture Patterns In Age Group 8-10 Years

Growth in terms of weight and height exponentially increases in this group as shown in table 1(b) (32.67±8.21kg, 139.73±5.95cm and 28.84±8.41kg, 136.71±11.43cm respectively for boys and girls). There is tendency for increased forward curves of spine and increase lumbar lordosis. However as age advances, these variations becomes less prominent and no corrective measurements are required[14]. Percentage of normal posture was 60% (boys) and 71.4% (girls) as shown in Table II.

Posture Patterns In Age Group 10-12 Years

Weights and heights for this group were found to be 34.66±7.02kg and 144.79±4.28cm (boys) respectively and 35.12±6.89kg and 142.22±9.04cm (girls) respectively. There was no significant difference ($p>0.05$) found between weight and height of boys and girls in this age group, though girls show slightly higher values of weight as compared to their male counterparts. As both genders are approaching puberty, girls show a greater increase in weight due to increased fat deposition in specific parts of body[16]. Greater variations in posture were observed in this group especially in girls (30.8% girls had normal posture as compared to 64.3 % boys). Highest postural variations seen among girl participants were sway back posture (23.1%), increased lumbar lordosis (23.1%) and kypholordotic posture (15.4%). This could be because as puberty marks its point, a girl often feels shy of the anatomical changes[17], hence adopting the posture leading to forward shoulder, sway back and kypholordotic posture, along with other compensatory variations.

Posture Patterns In Age Group 12-14 Years

There was an increase in both weight and height in boys and girls, with a statistically significant difference found between weights and heights of 12-14 year old boys as compared to those of 10-12 years of age, clearly demarcating onset of puberty from this age onwards. Postural variations commonly found were kypholordotic posture (46.2%) among girls and sway back (26.7%) among boys, with 30.8% girls and 60.0% boys having normal posture.

Overall comparison of all age groups between 4-14 years of age showed that as age increases in girls, incidence of poor posture increases especially the spinal variations. In boys, although no such significant trend was seen, there were increased postural variations as the age increases.

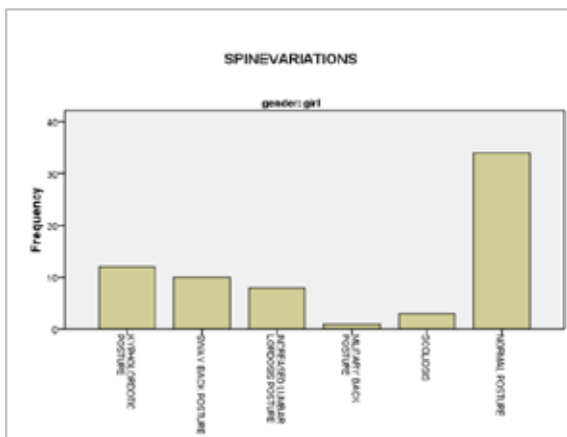
This could be because of growing insecurities and mental confusions as children approach puberty, influencing their habitual adaptations of specific body postures, with relative physical inactivity also playing a role as age advances. Scoliosis showed a trend of occurrence around the age of 10-12 years.

CONCLUSION

In present study age showed a significant relation with development of various posture patterns. There is a necessity to take conscious efforts and compulsory education in children about importance of having good posture and taking efforts for maintenance of normal posture right from the early years of life. Further research should be carried out in future to examine effects of postural variations on efficiency of muscles and skeletal system in age group of 4-14 years.

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Figure II: COMPARISON OF VARIOUS SPINAL VARIATIONS AMONG GIRL STUDENTS FROM AGE GROUP 4-14 YEARS



REFERENCE

1. Kisner CC, Colby LA. Therapeutic Exercise: Foundations and Techniques, F.A. Davis Company, Philadelphia, 2007, 5th ed. || 2. Kauffman T. Impact of aging-related musculoskeletal and postural changes on falls. *Top geriatr rehabil*, 5(2): 34-53. Jan 1990 || 3. Schubbe J. Good posture helps reduce back pain. *Spine Health*, May 2004. [online]. Available on: <http://www.spine-health.com/wellness/ergonomics/good-posture-helps-reduce-back-pain>. [Accessed July, 6, 2014] || 4. Peper E, Lin IM. Increase or Decrease Depression: How Body Postures Influence Your Energy Level. *APBI*, 40(3): 125-130. Fall 2012 || 5. EHE Newsletter, "Spine Health and Posture," *Spine Health and Posture*, 13(23), June 2013. [Online]. Available on: https://www.eheadme.com/news_articles/549652606. [Accessed July 8, 2014] || 6. Chapter 3 Factors Influencing Human Postures. Available: www.maia.ub.es/~inma/tesis/Chapter3.pdf [Accessed on: July 7, 2014] || 7. Angyan L, Tezely T, Angyan Z. Factors affecting postural stability of healthy young adults. *Acta Physiol Hung*. 94(4): 289-299. Dec 2007 || 8. Georgopoulos NA, Markou KB, Theodoropoulou A. Growth, pubertal development, skeletal maturation and bone mass acquisition in athletes. *Hormones (Athens)*, 3(4): 233-243. Oct-Dec 2004 || 9. Rogol AD, Roemmich JN, Clark PA. Growth at Puberty. *Journal of Adolescent Health*. 31: 192-200. 2002 || 10. Kumar V, Venkataraghavan K, Krishnan R. The relationship between dental age, bone age and chronological age in underweight children. *J Pharm Bioallied Sci*, 5(1): 73-79. Jun 2013 || 11. Norkin C, Levangie P. Posture. Joint structure and function, Baltimore: Williams and wilkins, Philadelphia, 1992, 428-432 || 12. Nissinen M. Spinal posture during pubertal growth. *Acta paediatr*. 84: 308-312. 1995 || 13. Willner S, Johnson B. Thoracic Kyphosis and lumbar Lordosis during the growth period in children. *Acta Paediatr Scand*. 72: 873-878. 1983 || 14. Malina RM, Bouchard C. Growth, Maturation, and Physical Activity. Champaign, IL; Human Kinetics. 1991 || 15. Nissinen M, Heliovaara M, Seitsamo J. Trunk asymmetry, posture, growth, and risk of scoliosis. *Spine*. 18(1): 8-13. 1993 || 16. Kaplowitz PB. Link Between Body Fat and the Timing of Puberty. *Pediatrics*. 121(3): 208-217. Feb 2008 || 17. Mendle J, Turkheimer E, Emery RE. Detrimental Psychological Outcomes Associated with Early Pubertal Timing in Adolescent Girls. *Dev Rev*. 27(2): 151-171. Jun 2007 |