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Effect of Prolonged Sitting on Posture in Children of Age 8-15 Years

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ABSTRACT

Aim: To assess the effect of prolonged sitting on posture in children.
Method: 151 children between the age of 8 – 15 years were included in the study from schools of Mangalore. They were then evaluated for standing posture in anterior and left lateral view with the use of an app Physiocode, photographs were clicked and analyzed in the app. The collected data was summarized by using the Descriptive Statistics: frequency, percentage; mean and S.D. The effect of prolonged sitting on posture (Both anterior and left later view); the mean and S.D. will be used. Data was analyzed by using the SPSS software version 29.0.10.
Result: It was seen that there is high significance for deviation of posture from the normal. In anterior view there is increased left lateral bending 37.8 %, elevation of the shoulder to the right 34.5 %, elevation of pelvis to the right 47.3%, knees were neutral. And in lateral view there was forward headed posture 42.6%, anteversion of pelvis 98.0%. In left lateral view of body alignment there was posterior tilt 50.7 % seen. Left lateral view of body vertical trunk alignment posterior tilt 61.5 % was seen.
Conclusion: The prolonged sitting effects child's posture and can cause poor posture in children as they are in developing age range when education starts. If poor posture continues for long term at this age, which leads to increased forward head posture, Kyphosis and functional scoliosis and also anterior pelvic tilt. Which leads to further consequences regarding posture in adolescents. Hence the seating arrangement for children in school should be evaluated for their postural needs. And an early ergonomic intervention focusing on furniture and school environment. Early pediatric physiotherapy attention for diagnosis and management is must to prevent further complications. And focusing on the ergonomics of the seating arrangement.

Keywords: seated posture, school going children, posture development, poor posture, good posture, Pediatric physiotherapy

INTRODUCTION

The relationship between human body parts in the upright position is understood as human posture. The final body posture involves head, neck, trunk, upper and lower limbs. In standing good posture is ergonomically advantageous and mechanically effective while moving and for the normal function of internal organs. [1] Posture keeps changing and its development is associated with body mass and height, physical activity and school furniture. Spinal curvature is liable as a as a result of rapid growth. Thoracic kyphosis is

dominant with poor muscle tone stabilizing the spine at the age of 6-7 years.

Initially cervical lordosis stabilizes and increases in strength of back muscles and there is increase in lumbar lordosis at the age of 8-11 years of age. Changing lifestyle and school education may worsen the posture between the age 6-10 years. By carelessness and slenderness, the adolescents predispose one to deteriorating posture. As child grows anteroposterior spinal curvature change as shown in previous studies. Increase in forward translation displacements of the head, shoulder, pelvis and knees in sagittal plane is characterized by postural evolution during childhood

With rapid changes in height and weight, and as a result of adaption to new proportions, posture also changes during pre-adolescent phase and adolescence are periods of life. [2] Poor posture is change in body posture that deviates from the normal state, is a serious problem associated to normal physical development in children. Young school-age children's spines are characterized by rapid growth and high susceptibility to diseases caused by external factors as skeletal systems of young school-age children are in the developmental stage. Stabilization of the anterior and posterior curvatures of the spine is incomplete during this period

Children are required to spend more time sitting at desks and chairs When children begin attending School their lifestyle is markedly changed. Morphological development of the spine, further leading to Scheuermann's Kyphosis and impair lung function due to Long-term incorrect posture beginning at this stage. [3] One of the most popular yet underestimated health problems is body posture failures in children and adolescents. Some of the consequences of untreated incorrect body posture, reduction in cardio-respiratory efficiency, decreased vital capacity of the lungs, degenerative bone and low back pains, as well as the displacement of the internal organs. [4]

Children and adolescents remain sitting for long periods in a school along with sedentary lifestyle adopted in the school phase, may lead to Postural changes. A considerable growth is seen in the cases of postural changes in adolescence. Lateral and anteroposterior postural changes are led by such behaviours. [5]

There are three reference Planes in which body posture is described and considered: sagittal, coronal and transversal. [1] Typical feature of good body posture in the sagittal plane represented by physiological sagittal spinal curvature. The thoracic argument is curved posteriorly (kyphosis), cervical and lumbar spine are curved anteriorly (lordosis). Eye level corresponds to horizontal plane is when head remains horizontal, position of chin just above the sternum. Lower limb joints remain in neutral position and pelvis inclined anteriorly. [1]

Experts of several countries states that increase in poor posture and spinal deformity in children. A characteristic of hypokinesia and long term over loading of locomotory system in sitting in postural disadvantageous position is found to be the cause. An ideal condition for poor posture and spinal deformities are the increasing amount of time spent sitting once the child starts attending school and natural movements starts to decrease. [6] A body shape detrimental to the organism, resulting from anatomy and habitual or involuntary positioning of individual body parts is defined to as incorrect posture. [7] Increase in risk of posture defect is due to commencement of school education, and also lifestyle change. The proportion between head and rest of the body starts of resemble as that of the adult, whereas extremities become longer which is seen in school aged children. [8] There is direct association seen between posture and the physical growth in children. Postural disorder is rooted in childhood which is then observed in adult, and in a number of age groups it is prevalent. As child's skeletal system is mutable and gets easily modified,

it is very important to diagnose these disorders. [9]

MATERIALS & METHODS

Source of data:

Informed consent form will be obtained from the parents of the subjects. A brief introduction about the procedure will be explained to all the subjects. Participants will be recruited from that school on the basis of the inclusion and exclusion criteria and an initial examination including demographic data will be taken and posture evaluation will be performed.

Inclusion criteria:

8-15 years of age group.
Both gender with typical development.

Exclusion criteria:

Neurologic or Orthopedic diagnoses.
History of developmental delay or balance impairments.
History orthopedic surgeries within the past 6 months.
All diagnostic conditions and surgical histories were identified through parent report.

Collection of data

Population: Children of 8-15 year
Sampling: Schools in Mangalore, India
Sample size: 151
Type of Study: Descriptive study
Duration of the study: 1 month

Outcome measure:

Posture evaluation:

Posture alignment assessment was done by using digital photographs and analyzed using the camera of an android phone (Samsung A12) and PhysioCode Posture (PCP) app available for both IOS and Android. Standing Anterior and Left Lateral view the posture was analyzed. Participant was asked to stand facing the camera for anterior view and was asked to stand at the left side for Left lateral view. [10]

STATISTICAL ANALYSIS

The collected data was summarized by using the Descriptive Statistics: frequency, percentage; mean and S.D. The effect of prolonged sitting on posture (Both anterior and left later view); the mean and S.D. will be used. Data was analyzed by using the SPSS software (SPSS Inc.; Chicago, IL) version 29.0.10.

RESULT

It was seen that there is high significance for deviation of posture from the normal. In anterior view there is increased left lateral bending 37.8 %, elevation of the shoulder to the right 34.5 %, elevation of pelvis to the right 47.3%, knees were neutral. And in lateral view there was forward headed posture 42.6%, anteversion of pelvis 98.0%. In left lateral view of body alignment there was posterior tilt 50.7 % seen. Left lateral view of body vertical trunk alignment posterior tilt 61.5 % was seen.

	Frequency	Percent
11.00	17	11.5
12.00	34	23.0
13.00	48	32.4
14.00	38	25.7
15.00	13	7.4
Total	151	100.0
Gender		
	Frequency	Percent
F	79	53.4
M	72	46.6
Total	151	100.0

Anterior view-Head		
	Frequency	**Percent**
Aligned	87	58.8
Left Lateral Bending	56	37.8
Right Lateral Bending	5	3.4
Total	148	100.0

Anterior view-Shoulder		
	Frequency	**Percent**
Aligned	72	48.6
Elevation To the Left	25	16.9
Elevation To the Right	51	34.5
Total	148	100.0

Anterior view-Pelvis		
	Frequency	**Percent**
Aligned	66	44.6
Elevation To the Left	12	8.1
Elevation To the Right	70	47.3
Total	148	100.0

Anterior view-Right knee		
Frequency	**Percent**	
	Frequency	**Percent**
Aligned	1	.7
Elevation To the Right	1	.7
Neutral	146	98.6
Total	148	100.0

Anterior view-Left knee		
	Frequency	**Percent**
Neutral	147	99.3
Varus	1	.7
Total	148	100.0

Left lateral view-Head		
	Frequency	**Percent**
Aligned	72	48.6
Protrusion	63	42.6
Retraction	12	8.1
Right Lateral Bending	1	.7
Total	148	100.0

Left lateral view-Pelvis		
	Frequency	**Percent**
Aligned	1	.7
Anteversion	145	98.0
Elevation To the Right	1	.7
Retraction	1	.7
Total	148	100.0

Left lateral view-Left knee		
	Frequency	**Percent**
Aligned	88	59.5
Anteversion	2	1.4
Elevation To the Right	1	.7
Flexed	55	37.2
Hyperextended	2	1.4
Total	148	100.0

Left lateral view-Body vertical alignment		
	Frequency	**Percent**
Aligned	55	37.2
Forward tilt	17	11.5
Neutral	1	.7
Posterior tilt	75	50.7
Total	148	100.0

Left lateral view-Body vertical trunk alignment		
	Frequency	**Percent**
Aligned	55	37.2
Forward tilt	1	.7
Neutral	1	.7
Posterior tilt	91	61.5
Total	148	100.0

		Age
N		148
Mean		12.939
Median		13.000
Std. Deviation		1.132
Range		5.000
Minimum		10.000
Maximum		15.000
IQR	25	2.000

	Anterior view-Head	Anterior view-Shoulder	Anterior view-Pelvis	Anterior view-Right knee	Anterior view-Left knee	Left lateral view-Head	Left lateral view-Pelvis	Left lateral view-Left knee	Left lateral view-Left ankle	Left lateral view-Body vertical alignment	Left lateral view-Body vertical trunk alignment
N	148	148	148	148	148	148	148	148	148	148	148
Mean	1.930	.656	1.433	-2.701	-1.764	-3.894	-10.830	-3.157	-2.786	-.976	-3.789
Median	1.950	.550	1.500	-2.750	-1.500	-4.300	-12.300	-3.800	-2.650	-1.200	-4.200
Std. Deviation	2.819	2.207	1.907	2.592	2.553	7.696	21.683	10.389	3.503	1.687	2.356
Range	15.100	11.000	10.000	12.600	12.800	74.100	318.400	127.500	17.000	7.600	14.500
Minimum	-7.100	-4.500	-4.100	-8.600	-9.000	-36.500	-75.700	-16.600	-11.900	-4.700	-10.000
Maximum	8.000	6.500	5.900	4.000	3.800	37.600	242.700	110.900	5.100	2.900	4.500
IQR 25	3.800	1.225	2.275	3.575	-3.300	-7.500	.000	-7.785	-5.725	-2.000	-2.875

Anterior view-Head					
	N[a]	**Mean**	**Std. Deviation**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Aligned	87	.5908	1.62985	.2434	.9382
Right Lateral Bending	5	-4.7600	1.73724	-6.9171	-2.6029
Left Lateral Bending	56	4.6071	1.63249	4.1700	5.0443
F=146.034 p<.001 vhs (very highly significant)					

Anterior view-Shoulder					
	N	**Mean[a]**	**Std. Deviation**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Elevation to the Right	51	3.0647	1.15027	2.7412	3.3882
Elevation to the Left	25	-2.5280	.79242	-2.8551	-2.2009
Aligned	72	.0556	.91665	-.1598	.2710
a. F=296.052 P,0.001 vhs (very highly significant)					

Anterior view-Pelvis					
	N[a]	**Mean**	**Std. Deviation**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Elevation to the Right	70	2.9957	1.05287	2.7447	3.2468
Elevation to the Left	12	-2.5667	.69978	-3.0113	-2.1220
Aligned	66	.5030	.71057	.3283	.6777
a. F=265.483 p<0.001 vhs (very highly significant)					

Anterior view-Right knee					
	N	**Mean**	**Std. Deviation**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Neutral	146	-2.7507	2.56986	-3.1710	-2.3303
Elevation to right	1	2.1000	.	.	.
Aligned	1	-.2000	.	.	.

Anterior view-Left knee					
	N	**Mean**	**Std. Deviation**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Neutral	147	-1.7143	2.48973	-2.1201	-1.3084
Varus	1	-9.0000	.	.	.

Left lateral view-Head					
	N[a]	**Mean**	**Std. Deviation**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Aligned	72	-.7750	2.78177	-1.4287	-.1213
Protrusion	63	-9.7016	3.62093	-10.6135	-8.7897
Retraction	12	10.6000	9.21442	4.7454	16.4546
Right Lateral bending	1	-36.5000	.	.	.
a. F=133.978 p<0.001 vhs (very highly significant)					

Left lateral view-Pelvis					
	N	**Mean**	**Std. Deviation**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Antiversion	145	-12.7372	5.26508	-13.6015	-11.8730
Aligned	1	-4.3000	.	.	.
Retraction	1	5.7000	.	.	.
Elevation to the Right	1	242.7000	.	.	.
Left lateral view-Left knee					
	N	**Mean[a]**	**Std. Deviation**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Flexed	55	-8.1964	2.26666	-8.8091	-7.5836
Aligned	88	-1.3409	2.36840	-1.8427	-.8391
Hyperextended	2	7.6500	2.19203	-12.0446	27.3446
Elevation to Right	1	110.9000	.	.	.
Anteversion	2	-12.3000	.00000	-12.3000	-12.3000
. F=700.686 p<0.001 vhs (very highly significant)					

Left lateral view-Left ankle					
	Nª	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Dorsiflexion	41	-7.0707	1.52007	-7.5505	-6.5909
Aligned	106	-1.1774	2.50460	-1.6597	-.6950
Neutral	1	2.3000	.	.	.
F=101.631 p<0.001 vhs (very highly significant)					

Left lateral view-Body vertical alignment					
	Nª	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Posterior tilt	75	-2.2693	.85297	-2.4656	-2.0731
Aligned	55	-.2182	.76500	-.4250	-.0114
Neutral	1	2.3000	.	.	.
FOrward tilt	17	2.0824	.62773	1.7596	2.4051
. F=170.967 p<0.001 vhs (very highly significant)					

Left lateral view-Body vertical trunk alignment					
	Nª	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Posterior tilt	91	-5.2659	1.39349	-5.5561	-4.9757
Aligned	55	-1.5800	1.24297	-1.9160	-1.2440
Neutral	1	.9000	.	.	.
Forward tilt	1	4.5000	.	.	.
a. F=103.658 p<0.001 vhs (very highly significant)					

Correlations

		Anterior view-Shoulder	Anterior view-Pelvis	Anterior view-Right knee	Anterior view-Left knee	Left lateral view-Head	Left lateral view-Pelvis	Left lateral view-Left knee	Left lateral view-Left ankle	Left lateral view-Body vertical alignment	Left lateral view-Body vertical trunk alignment
Anterior view-Head	r	.343	.033	-.008	-.097	.119	-.225	-.278	-.006	-.107	-.087
	p	.000	.690	.923	.243	.150	.006	.001	.940	.196	.292
	N	148	148	148	148	148	148	148	148	148	148
Anterior	r		.436	-.052	.082	.184	-.133	-.101	.233	-.337	-.156

view-Shoulder	p		.000	.531	.322	.025	.108	.223	.004	.000	.058
	N		148	148	148	148	148	148	148	148	148
Anterior view-Pelvis	r			-.161	.031	.027	-.047	.016	.240	-.183	.036
	p			.050	.710	.748	.574	.849	.003	.026	.664
	N			148	148	148	148	148	148	148	148
Anterior view-Right knee	r				.132	.108	.093	.191	.237	-.053	.092
	p				.110	.192	.261	.020	.004	.524	.264
	N				148	148	148	148	148	148	148
Anterior view-Left knee	r					.047	.102	.124	.096	-.056	-.030
	p					.570	.218	.132	.246	.497	.715
	N					148	148	148	148	148	148
Left lateral view-Head	r						-.439	-.224	.196	-.119	.090
	p						.000	.006	.017	.150	.276
	N						148	148	148	148	148
Left lateral view-Pelvis	r							.873	.103	.144	.130
	p							.000	.214	.080	.116
	N							148	148	148	148
Left lateral view-Left knee	r								.422	.070	.183
	p								.000	.401	.026
	N								148	148	148
Left lateral view-Left ankle	r									-.592	.043
	p									.000	.606
	N									148	148
Left lateral view-Body vertical alignment	r										.546
	p										.000
	N										148

DISCUSSION

A study found to have increased percent of forward headed posture as a result of incorrect use of heavy backpack, prolonged hours in incorrect postures in school and in front of computer, also lack of ergonomic school furniture. [11] From 10 – 12 years age to 16 - 20 years the low back pain odds ratio increased according to the European review. Several body regions are affected by the classroom furniture and layout design. Seat backrest height and seat to black board distance and too low desk were the factors for low back and neck pain. Several studies found due to chair height and desk height being too low and chair backrest being too curved, it led to musculoskeletal pain. This highlights that the need for effective ergonomic intervention aiming to the physical factors in school. [12] The direct influence on posture and axial support for human body is from the spinal column. Correct anatomical curvatures of the spinal column can be modified mostly with incorrect sitting position for long hours. Appearance of scoliosis, hyper lordosis and hyper kyphosis can occur if the curvatures are modified. Modified curvatures can be seen in upright standing up position. The study states that the overall standing up position of the children is affected by sitting for prolonged hours in incorrect posture in school benches. [13] Li C et al 2022 found significant correlation between sagittal angle of spine in different posture. The post sitting posture associated with sagittal angle abnormalities impact the shape of spine such that sagittal imbalance was also observed when students are in natural standing. [3] Sainz de Baranda et al 2020 found that some percentage of children had slight thoracic hyper kyphosis and moderate lumbar hyper kyphosis although there were no clinically relevant differences. [14] Tiwari et 2022 found that there is no impact of prolonged sitting on a sagittal plane postural angle on upper limb angle Craniohorizontal angle, Craniovertebral angle, and sagittal shoulder angle. [15] In our study it was found to have a significant correlation between the prolonged sitting and incorrect posture, the results shows that most of the children in anterior view had increased left lateral bending, elevation of the shoulder to the right, elevation of pelvis to the right, knees were neutral. And in lateral view there was forward headed posture, anteversion of pelvis. In left lateral view of body alignment there was posterior tilt seen. Left lateral view of body vertical trunk alignment posterior tilt was seen. Hence there is high significance found between prolong sitting and posture in children. However further investigation is required for in depth insight on the ergonomic modification and the blackboard distance in school as it was not included in this study.

CONCLUSION

It is found that prolonged sitting affects child's posture and can cause poor posture in children as they are in developing age range when education starts. If poor posture continues for long term at this age, it may have an effect on the morphological development of the spine, which leads to increased forward head posture, Kyphosis and functional scoliosis and also anterior pelvic tilt. Which leads to further consequences regarding posture in adolescents. Hence the seating arrangement for children in school should be evaluated for their postural needs. And an early ergonomic intervention focusing on furniture and school environment.

Declaration by Authors

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