International Journal of Science and Healthcare Research
Vol.4; Issue: 3; July-Sept. 2019
Website: www.ijshr.com
Original Research Article *ISSN: 2455-7587*

Effect of Upper Limb Activity on Erector Spinae Muscle During Different Sitting Postures Among Non Specific Low Back Pain Students Aged (18-21 Years): A Cross Sectional Comparative Study

Dr. Abhijeet Arun Deshmukh[1], Dr. Shraddha Bharat Chijwani[2]

[1]Associate Professor, VSPM's College Of Physiotherapy, Nagpur, India.
[2]Intern, VSPM's College Of Physiotherapy, Nagpur, India.

Corresponding Author: Dr. Shraddha Bharat Chijwani

ABSTRACT

Aim: To study effect of upper limb activity on erector spinae muscle during different sitting postures among non specific low back pain students aged 18-21 years.
Materials and methods: 50 students from medical institutions (MBBS, BPTH, BDS, Nursing) in the age group of 18-21 years participated in the study for 6 months.
Result: Significant difference were revealed on the EMG values during high sitting and cross sitting at rest (p=0.0006). In comparison among females and males significant difference is seen in high sitting and cross sitting at rest with p value 0.025 and 0.006. There was no significant difference in erector spinae muscle activity between high sitting and cross sitting during unilateral and bilateral upper limb elevation.
Conclusion: The study result reveal that the amplitude of erector spinae muscle is more in high sitting as compared to cross leg sitting at rest, which shows erector spinae muscle works more in high sitting position as compared to cross leg sitting, whereas in unilateral or bilateral upper limb elevation activity (amplitude) of erector spinae muscle increases in high sitting as well as cross leg sitting position.

Keywords: Surface EMG, Erector spinae, Low back pain, Adolescence, High sitting, Cross sitting.

INTRODUCTION

The sedentary demands of modern life results in people spending more time sitting. [1] Sitting generates a prolonged flexed posture of the lumbar spine, which is commonly associated with the development of low back pain disorders. [1,2] In standing, forward bending leads to high levels of lumbar flexion, have been associated with increased intradiscal pressure, elevated disc degeneration, higher disc herniation rates and higher compressive forces compared to standing. [1-3] As the lumbar spine flexes it undergoes a change in configuration that influences the role played by the passive tissues of the spine and the active contribution of the erector spinae. [4] Non - specific low back pain is tension, soreness or stiffness in the back, [5] which can vary from mild to severe [1] and can caused by history of traumatic injury, lumbar strain, postural strain. [6] Previous studies found that 85% of the population are classified as 'non-specific low back pain'. [6,7]

Study conducted in India (Delhi), 39.8% of adolescent (17-25 years) population is found to suffer from low back pain. [8] Another studies found that prolonged sitting posture for 7-8hours has been shown to cause low back pain. [9-11] In Indian scenario unsupported floor sitting postures, especially cross leg sitting are common for day to day activities, which decreases muscle activity and reduces fatigue when working over an extended period. [12-15] Muscle activities of the trunk (erector spinae, oblique externus abdominis, rectus abdominis, latissimus dorsi) during upper limb movements are thought to be important for maintaining postural stability by relaxing trunk muscles. [13,16,17,18] Postural control depends on the integrity of nervous system, musculoskeletal system &

special senses. [12,19] Patterns of trunk muscles activity is highly influenced by lumbar posture. [19] Erector spinae muscle is primary superficial back extensor muscle [20] which also acts as antagonist to abdominal muscles & control movement of trunk during forward bending activities. [21] The lumbar erector spinae lies lateral to the multifidus & forms the prominent dorsolateral contour of back muscles in lumbar region. [21]

Electromyography (EMG) studies have shown that upright spinal postures in sitting require more extensor muscles (ilicostalis, longissimus thoracis) activity than kyphotic postures(slumped). [20,22,23] During upright sitting, co-contraction of spinal stabilizing muscles such as superficial lumbar erector spinae, transverse abdominis, multifidus, is observed [23,24,25] whereas in contrast, passive postures such as sway back standing and slump sitting have been shown to result in decreased activation of these muscles. [23,24,26] Abnormal progressive curvature is related to postural asymmetry which negatively affects physical activity in adolescent. [27-29]

Surface-EMG (S-EMG) is the recording of electrical activity of motor unit of muscle. [30] Muscle activation patterns depend on many factors, such as neurophysiological, biomechanical and types of movement. [31] The response of fibres comprising a motor unit when they contract in response to an action potential is on electrical disturbance called the motor unit action potential (MUAP). [30] Surface electrode is used for monitoring large superficial muscle. [30] If two motor unit contract at the same or adjacent muscle the activity from the fibres or both unit will be summated and recorded as one large potential when using surface electrode. [30,32] S-EMG has been widely utilized to study changes in trunk and lower extremity muscle activities. [30] The use of S-EMG technique has played a major role in understanding of the functional activity of lumbar muscles in both healthy and low back pain subjects by placing the S-EMG within the border of the muscle along the muscle orientation. [19,30] A S-EMG is non-invasive and reliable method to evaluate functional activity of trunk muscles. [19,30]

Previous research reported effects of posture, effects of movement direction, and effects of arms speed on trunk muscle activities. [16] This research focused mainly on the timing of muscle activities during movements in upright & slumped sitting among 22 subjects, this study showed that different upright sitting postures result in altered trunk muscle activity. [16] Another study conducted by Nicolas (2014) evaluated erector spinae muscle activity in standing and found increased muscle activity in trunk flexion, full flexion, and extension. [33]

There is no research has been done on the effect of upper limb activity on erector spine muscle during different sitting postures (cross leg sitting and sitting with foot supported) among , non-clinical students with non specific low back pain between aged 18-21 years.

Non specific low back pain is a common condition among 17-25 years of age group. [9] It was found that low back pain results from staying in sitting position for long time (7-8hrs). [9] Study have been conducted, to compare surface EMG on trunk muscles among low back pain patients and pain free controls (age 25yrs) in different sitting postures and found that trunk muscle activity increases in long lordosis (i.e. thoracolumbar lordosis) as compared to short lordosis (i.e. thoracic kyphosis with lumbar lordosis) postures in patients with low back pain as compared to controls. [1] A similar study conducted by Nicolas (2014) evaluated erector spinae muscle activity in standing and found increased muscle activity in trunk flexion, full flexion, and extension. [33]

Therefore, the current study was targeted to evaluate the upper limb activity on erector spinae muscle during cross legs sitting and sitting posture with foot supported among non specific low back pain students (because they spend most of time attending lectures) between 18 to 21 years of age, hence present study was undertaken.

OBJECTIVES

- To evaluate activity of erector spinae muscle at rest in high sitting & cross leg sitting posture among non specific low back pain students.
- To evaluate activity of erector spinae muscle after bilateral and unilateral upper limb elevation in high sitting & cross leg sitting among non specific low back pain students.

MATERIALS AND METHODS

STUDY AREA: Lata Mangeshkar college and Hospital, Hingna, Nagpur (Maharashtra).

STUDY SETTING: A Cross- sectional comparative study.

SAMPLES: Total=50 (25 males and 25 females).

Study protocol was prepared. Permission was taken from the principal of VSPM's college of Physiotherapy. Permission was taken from ethical committee. Subjects were selected according to inclusion criteria. Total 50 subjects of 18-21 yrs of age were selected from various branches (MBBS, Physiotherapy, BDS and Nursing). Subjects were randomly selected from different branches which were n=1050, from which subjects were asked who have non- specific low back pain i.e. subjects who spend 7-8 hours in sitting and 69 subjects were screened, but only 50 subjects were selected (25 males, 25 females), who were willing to participate in study and fits in inclusion criteria. The procedure of study was explained in detail to the subjects. Once the participants were convinced, the written consent was obtained. Demographic data was recorded in EMG machine (RMS EMG .EP MARK II) taken from subjects like Name, age, gender was taken. Height & weight was measured. BMI was calculated. To calculate EMG of erector spinae muscle, motor unit action potential was recorded. Each participant was asked to sit in high sitting position. Lower back area were exposed, skin over dominant side erector spinae muscle at L_3 was cleaned with spirit to reduce skin resistance. [34] Bar stimulating electrode was placed at L_3 level (about 4 cm lateral from midline measured with the help of measuring tape). [34] Centre to centre electrode distance was 2.5 cm, electrodes were longitudinally oriented along the fibres of the muscle. A reference electrode was taped on the dominant wrist. The EMG signals was amplified by 1000 with a frequency band pass of 20-500Hz. [34] Data was recorded first at rest then with unilateral upper limb elevation then with bilateral upper limb elevation in high sitting with foot supported position. A minute break was given and the same procedure was performed in cross leg sitting with same subjects. The data obtained was then analysed.

INCLUSION CRITERIA

- Subjects / students willing to participate. [35]
- Non specific low back pain in last 3 months duration both male, female. [35]
- Students age group 18-21 years. [35]
- Able to perform bilateral upper limb overhead elevation activity. [35]

EXCLUSION CRITERIA

- History of spine injury or trauma in last 6 months. [34]
- Subject with neurological involvement. [34]
- Subjects with BMI more than 24.9. [34]
- History of shoulder injury causing difficulty in overhead activities. [34]
- History of acute low back pain. [34]

STATISTICAL ANALYSIS

Descriptive Statistics:- Mean standard deviation was calculated to summarize quantitative variables. Independent-Age, Gender, Weight, BMI. Frequency and percentage was calculated to summarized categorical variables duration, amplitude & rise time was recorded.

Inferential Statistics:- Inferential statistics included test of significance like paired t test for comparison of effects of upper limb activity on erector spine muscle with high sitting and cross leg sitting. p <0.05 was considered statistically significant.

RESULTS

The demographic data of subjects (18-21years) i.e. age, height, weight, BMI were explained in table 1. Readings of motor unit action potential (duration, amplitude, rise time) of erector spinae muscle in high sitting and cross sitting at rest were shown in table 2. Readings of motor unit action potential (duration, amplitude, rise time) of erector spinae muscle in high sitting and cross sitting during unilateral upper limb elevation were shown in table 3. Readings of motor unit action potential (duration, amplitude, rise time) of erector spinae muscle in high sitting and cross sitting during bilateral upper limb elevation were shown in table 4.In table 5 shows the mean and standard deviations of motor unit action potential (duration, amplitude, rise time) of erector spinae muscle in high sitting and cross leg sitting at rest among females and males. Table 6 shows the mean and standard deviations of motor unit action potential (duration, amplitude, rise time) of erector spinae muscle in high sitting and cross leg sitting during unilateral upper limb elevation among females and males. Table 7 shows the mean and standard deviations of motor unit action potential (duration, amplitude, rise time) of erector spinae muscle in high sitting and cross leg sitting during bilateral upper limb elevation among females and males.

Table 1: DEMOGRAPHIC DATA

PARAMETERS	FEMALES(n=25)		MALES(n=25)	
	MEAN	±SD	MEAN	±SD
AGE(yrs)	19.52	1.22	19.12	1.166
HEIGHT(cms)	160.912	5.401	167.8	2.677
WEIGHT(kgs)	50.92	6.2151	62.16	7.35
BMI(kg/m^2)	19.708	1.905	22.068	1.9054

Table 2: AT REST

VARIABLES	HIGH SITTING REST		CROSS SITTING REST		*p* VALUE
	MEAN	±SD	MEAN	±SD	
DURATION(ms)	5.36	1.11	5.2	1.09	0.442
AMPLITUDE(µv)	7.47	5.6	5.58	3.18	0.0006*
RISE TIME(µs)	1775.3	545.8	1682.1	377.5	0.36

Table 2 revealed that activity of erector spinae muscle showed statistically significant increase value at rest in high sitting position (7.47±5.6) than cross sitting position (5.58±3.1) with p value 0.0006.

Table 3: UPPER LIMB ELEVATION (ULE)

VARIABLES	HIGH SITTING -ULE		CROSS SITTING –ULE		*p* VALUE
	MEAN	±SD	MEAN	±SD	
DURATION(ms)	5.73	1.2	5.57	0.87	0.376
AMPLITUDE(µv)	8.93	7.2	7.67	5.12	0.106
RISE TIME(µs)	1788	399.2	1758	350.6	0.673

Table 3 revealed that high sitting unilateral upper limb elevation & cross sitting unilateral upper limb elevation had shown significant increase in value of erector spinae muscle activity (amplitude) with upper limb elevation, but these values are not shown statistically significance.

Table 4: BILATERAL LIMB ELEVATION(BLE)

VARIABLES	HIGH SITTING -BLE		CROSS SITTING –BLE		*p* VALUE
	MEAN	±SD	MEAN	±SD	
DURATION(ms)	5.2	0.86	5.4	1.03	0.172
AMPLITUDE(µv)	10.25	8.05	9.25	5.16	0.355
RISE TIME(µs)	1739	336.4	1766	401.1	0.693

Table 4 revealed that high sitting bilateral upper limb elevation & cross sitting bilateral upper limb elevation had shown significant increase in value of erector spinae muscle activity (amplitude), but these values are not shown statistically significance.

TABLE 5: GENDER WISE COMPARISON AMONG HS-REST V/S CS-REST

GENDER	VARIABLES	HIGH SITTING REST		CROSS SITTING-REST		*p* VALUE
		MEAN	±SD	MEAN	±SD	
FEMALE	DURATION(ms)	5.52	1.22	5.42	1.25	0.72
	AMPLITUDE(µv)	8.8	6.9	6.74	3.69	0.025*
	RISE TIME(µs)	1764.4	396.2	1756.6	381.5	0.94
MALE	DURATION(ms)	5.19	0.99	4.99	0.88	0.46
	AMPLITUDE(µv)	6.15	3.53	4.43	2.05	0.006*
	RISE TIME(µs)	1786.3	671.6	1607.6	365.8	0.29

Table 5 revealed that high sitting & cross sitting at rest showed that duration and rise time of motor unit action potential of erector spinae muscle does not showed significant difference among females and males.

High sitting & cross sitting at rest had shown statistically significant increase in value of erector spinae muscle activity (amplitude) among females and males with *p* value 0.0025 and 0.006

TABLE 6: GENDER WISE COMPARISON AMONG HIGH SITTING-ULE V/S CROSS SITTING-ULE

GENDER	VARIABLES	HIGH SITTING- ULE		CROSS SITTING-ULE		*p* VALUE
		MEAN	±SD	MEAN	±SD	
FEMALE	DURATION(ms)	5.52	0.74	5.42	0.91	0.63
	AMPLITUDE(µv)	8.92	7.98	8.23	4.55	0.59
	RISE TIME(µs)	1713	312.3	1803.6	352.1	0.33
MALE	DURATION(ms)	5.95	1.52	5.71	0.834	0.46
	AMPLITUDE(µv)	8.93	6.49	7.12	5.67	0.034*
	RISE TIME(µs)	1863	464	1712.6	350.2	0.16

Table 6 revealed that high sitting & cross sitting during unilateral upper limb elevation showed that duration and rise time of motor unit action potential of erector spinae muscle does not showed significant difference among females and males.

High sitting & cross sitting during unilateral upper limb elevation had shown significant increase in value of erector spinae muscle activity(amplitude) among females and males, but males shown statistically significant increase with *p* value 0.034

TABLE 7: GENDER WISE COMPARISON AMONG HIGH SITTING-BLE V/S CROSS SITTING-BLE

GENDER	VARIABLES	HIGH SITTING- BLE		CROSS SITTING-BLE		*p* VALUE
		MEAN	±SD	MEAN	±SD	
FEMALE	DURATION(ms)	5.35	0.77	5.5	1.11	0.5
	AMPLITUDE(µv)	9.91	5.57	9.26	4.09	0.57
	RISE TIME(µs)	1741	301.5	1791	525.1	0.65
MALE	DURATION(ms)	5.15	0.94	5.4	0.97	0.15
	AMPLITUDE(µv)	10.59	10.04	9.24	6.13	0.47
	RISE TIME(µs)	1736	374.4	1740.6	226.7	0.96

Table 7 revealed that high sitting & cross sitting during bilateral upper limb elevation showed that duration and rise time of motor unit action potential of erector spinae muscle does not showed significant difference among females and males.

High sitting & cross sitting during bilateral upper limb elevation had shown significant increase in value of erector spinae muscle activity (amplitude) among females and males, but these values are not shown statistically significance.

DISCUSSION

The current study found that erector spinae muscle showed statistically significant increase amplitude at rest in high sitting position (i.e.7.47± 5.6 µV) compared to cross sitting position (5.58 ± 3.1 µV) i.e. *p*= 0.0006, while during unilateral &

bilateral upper limb elevation (duration, amplitude & rise time) Motor Unit Action Potential-MUAP of erector spinae muscle does not showed any significant difference in either genders.

Previous study done by Claus et al (2018) showed similar results of current study. They found that activity of lumbar iliocostalis muscle (which is the part of erector spinae) during short lordosis position among low back pain individuals was 8.1± 6.9 µV & subjects with no low back pain was 3.5 ± 2.3 µV. [34] These results is in supports with the present study among non-specific low back pain subjects, which showed slightly greater amplitude of erector spinae muscle at rest in high sitting position (i.e. short lumbar lordosis position).

Another study conducted by Astfalck RG et al (2010), found that amplitude of lumbar iliocostalis muscle among 17-25 years adolescent subjects with non specific low back pain(n=18) was 36.4± 33.0 µV in usual sitting position (subjects were asked to sit on stool as you would usually sit). [3] These results contradict the result of present study as amplitude values were higher compared to present study values. This might be due to smaller sample size compared to present study. The current study evaluated lumbar erector spinae muscle activity in functional high sitting with foot supported and cross leg sitting without backrest support. In present study no significant difference seen in motor unit action potential during unilateral and bilateral upper limb elevation because in both high sitting & cross leg sitting positions there is an increase in lumbar lordosis occurs (i.e. long lordosis posture). Due to the short duration of the sitting tasks, the effects of fatigue on sitting motor control were not considered. [33]

There is strong evidence to suggest that the hyperactive musculature behaviour serves to stiffen the spine, if maintained for long time, this adaptive muscle activity pattern can be problematic and result in further injury. [33] Activity of large superficial spinal extensor muscle i.e. erector spinae muscle was more affected by spinal curvature in low back pain patients. [34]

In present study, in high sitting position, the activity of erector spinae muscle (amplitude) found greater at rest and during both unilateral upper limb and bilateral upper limb elevation than compared to cross leg sitting position. This can be explained according to the study done by Peter O'sullivan (2006) stated that thoracic upright sitting (i.e. long lordosis posture) showed less erector spinae activity compared to, upright sitting, and slump sitting. [35]

Current study conclude that, at high sitting position amplitude of erector spinae muscle at rest is 7.47±5.6 µV, during unilateral upper limb elevation is 8.93±7.2µV and bilateral upper limb elevation is 10.25±8.05µV, which showed that activity(amplitude) of erector spinae muscle increases with upper limb elevation. [34]

Similarly in cross leg sitting activity of erector spinae muscle increases with upper limb elevation at rest is 5.58±3.18µV, during unilateral upper limb elevation is 7.67±5.12 µV and bilateral upper limb elevation is 9.25±5.16µV.

Hence in the present study two different types of sitting postures had shown significant difference in erector spinae muscle activity. But unilateral and bilateral upper limb elevation had shown significant increase in value of erector spinae muscle activity (amplitude) with upper limb elevation, but these values are not statistically significant. [34]

CONCLUSION

The study result revealed that the amplitude of erector spinae muscle is more in high sitting as compared to cross leg sitting at rest, which shows erector spinae muscle works more in high sitting position as compared to cross leg sitting, whereas in unilateral or bilateral upper limb elevation activity (amplitude) of erector spinae muscle increases in high sitting as well as cross leg sitting position.

REFERENCES

1. O'Sullivan PB, Dankaerts W, Burnett AF, Farrell GT, Jefford E, Naylor CS. Effect of different upright sitting postures on spinal-pelvic curvature and trunk muscle activation in pain free population. *Spine.2006;31(19): ppE707-E712.*
2. Castanharo R, Duarte M, McGill S. Corrective sitting strategies: An examination of muscle activity and spine loading *J. of electromyography & kinesiology.2014;24:114-115.*Available from: http://dx.doi.org/10.1016/j.jelekin.2013.11.001
3. Astfalck RG, O'Sullivan PB, Straker LM, Smith AJ. Sitting postures and trunk muscle activity in adolescents with and without nonspecific chronic low back pain. An analysis based on subclassification. *Spine .2010;35(14):pp1387-1388.*
4. Mawston GA, Boocock MG. The effect of lumbar posture on spinal loading and the function of the erector spinae : implications for exercise and vocational rehabilitation. *New Zealand journal of Physiotherapy.2012;40(3):135-140.*
5. Lynch k.Non-specific low back pain-Royal Berkshire Hospital. *Back pain advice.2015;(2):1-4.*Available from: www ipswichhospital.nhs.uk
6. Dankaerts W, O'Sullivan PB, Burnett A, Straker L .Altered pattern of superficial trunk muscle activation during sitting in non specific chronic low back pain patients.*Spine.2006;31(17):2017-2023.*
7. Dankaerts W, O'Sullivan P, Burnett A, and Straker L . Differences in sitting postures are associated with nonspecific chronic low back pain disorders when patients are subclassified. *Spine 2006;31(6):698-699.*
8. Aggarwal N, Anand T, Kishore J, Ingle GK .Low back pain & associated risk factors among undergraduate students of medical college in Delhi. *Education for health.2013;26(2):103-105* Available from: *https://www.researchgate.net/publication/258364149*
9. Mafuyai MY, Babangida BG ,Mador ES, Bakwa DD, Jabil yy .Non specific Low Back Pain-Physiopedia. *Academic journal of interdisciplinary studies.2014;3(5):23-24.*
10. Dieen JH, Selen LPJ Jacek C .Trunk muscle activation in low back pain patients, an analysis of the literature *.J. of electromyography & kinesiology. 2003; 13(4):333-51.* Available from: https://doi.org/10.1016/S1050-6411(03)00041-5
11. Yucel H, Torun P. Incidence & risk factors of low back pain in students studying at a health university. *Bezmialem Science. 2016;1:12-14.* Available from: https://doi:10.14235/bs.2016.618
12. Parikh TK, Arumugam S. Are Indian habits of cross -legged sitting & squatting associated with anterior knee pain? *J. Postgrad Med, Edu Res 2017;51(1):1-6.*
13. Hong J, Yu J, Lee D, Hwang Y, Ha J. The effect of one leg crossed sitting posture on the trunk muscle activities. *J.of convergence information technolo.2013;8(14):468-471.*
14. Snijders CJ, Slagter AH, van Strik R, Vleeming A, Stoeckart R, Stam HJ. Why leg crossing? The influence of common postures on abdominal muscle activity. *Spine 1995; 20(18):1989-1993.*
15. Snijders CJ, Hermans PF , Kleinrensink GJ. Functional aspects of cross- legged sitting with special attention to pyriformis muscle and sacroiliac joints. *Clincal Biomechanics.2006;21(2):116-121.*
16. Shiba Y, Obuchi S, Saitou C, Habata T, Maeda M. Effect of bilateral upper -limb on trunk muscles. *J. of Physical Therapy Science. 2001;13(1):65-67.*
17. Watanabe S, Kobara K, Yoshimura Y, Osaka H, Ishida H et al. Influence of trunk muscle co-contraction on spinal curvature during sitting. *J Back Musculoskelet Rehabil .2014;27(1):55-61.*
18. Willson JD, Dougherty CP, Ireland ML, Davis IM. Core stability and its relationship to lower extremity function and injury. *The journal of the American Academy of Orthopaedic Surgeons 2005;13:316-325.* Available from: https://doi:10.5435-200509000-00005.
19. Shah J, Veqar Z. Extensor trunk muscle activity during stabilization exercises: An update. *Physiother-J. Indian Assoc Physiother2017;11:12-14.* Available from: http://doi:10.4103/PJIAP.PJIAP_2_17

20. Floyd WF, Silver PH. The functions of the erector spinae muscle in certain movements & postures in man. *J.Physiol,(1955):184-203.*
21. Kisner C, Colby LA. Therapeutic exercise foundation and techniques. *The Spine: Structure, Function& Posture.6Edi.:418*
22. Claus AP, Hides JA, Moseley GL, Hodges PW. Different ways to balance the spine. Subtle changes in sagittal spinal curves affect regional muscle activity. *Spine 2009;34(6):E208-E214.*
23. O'Sullivan PB, Grahamslaw KM, Kendell M. The effect of different standing and sitting postures on trunk muscle activity in pain free population. *Spine 2002;27(11): 1238-44.*
24. Hashemirad F, Talebian S, Hatef B, Kahlaee A . The relationship between flexibility and EMG activity pattern of the erector spinae muscles during trunk flexion extension. *J. of Electromyography and Kinesiology. 2009;19:746-753.*
25. Martins LR, Marques NR, Ruzene JR, Morita AK, TavellaNavega M. Electromyographic activity and co-contraction of trunk muscles during exercises performed with an oscillatory pole: an analysis of the effect of different postures.2015;119-124. Available from: http://doi:10.590/1809-2950/12976422022015
26. O'Sullivan PB, Dankaerts W, Burnett A and Chen D. Evaluation of the flexion relaxation phenomenon of the trunk muscles in sitting. *Spine 2006;31(17):2009-2016.*
27. Jung JY, Park IS, Won Y, Kim BO, Bok SK, Kim JJ . Posture, pressure and muscle activation pattern of adolescent with idiopathic scoliosis in static and dynamic sitting. 2014*;11:E-2224-2902.*
28. Kouwenhoven JW, Castelein RM .The pathogenesis of adolescent idiopathic scoliosis: review of the literature. *Spine 2008;33(26):2898-2908*
29. Fortin C, Feldman DE, Cheriet F, Gravel D, Gauthier F, Labelle H . Reliability of a quantitative clinical posture assessment tool among persons with idiopathic scoliosis. *Physiotherapy2012;98(1):64-75.*
30. Danneels LA, Cools AM, Coorevits PL, Vanderstraeten GG, Cambier DC, Witvrouw EE, De Cuyper HJ et al. Difference in electromyographic activity in multifidus muscle & iliocostalis lumborum between healthy subjects & patients with sub acute chronic low back pain *.Eur Spine J .2002;11:13-19.*
31. Zaatar AM, Opavsky J,Uhlir P. Surface electromyography assessment of muscle activation patterns while sitting down in young healthy women and patients with ankylosing spondylitis.2011;*41(1):61-66.*
32. Joseph J, Mccoll I .Electromyography of muscles of posture: posterior vertebral muscles in males *.J. Physiol.1961;157:33-37.*
33. Mazis N .Does a history of non specific low back pain influence electromyographic activity of the erector spinae muscle group during functional movements? *J. Nov* Physiother.2014;4(4):1-11. Available from: http://dx.oi.org/10.4172/2165-7025.1000226
34. Claus AP, Hides JA, Hodges PW. Different ways to balance the spine in sitting; muscle activity in specific postures differs between individuals with and without a history of back pain in sitting. *Clinical Biomechanics. 2018;52:25-32.* Available from: https://doi.org/10.1016/j.clinbiomech.2018.01.003
35. Reiser FC, Durante BG, De'Souza WC, Mascarenhas LP, Bonuzzi GM. Paraspinal muscle activity during unstable superman & bodyweight squat exercises *J. Functional Morphology & Kinesiology2017;2(9):1-2.* Available from: http://doi:10.3390/jfmk2010009

How to cite this article: Deshmukh AA, Chijwani SB. Effect of upper limb activity on erector spinae muscle during different sitting postures among non specific low back pain students aged (18-21 years): a cross sectional comparative study. International Journal of Science & Healthcare Research. 2019; 4(3): 39-46.

******