ISSN No:-2456-2165

A Pilot Study to Find Out Whether Low Intensity Dynamic Exercise Causes Vertebral Column Height Reduction in Youngs

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Abstract:- Intervertebral discs contribute one fourth of the total vertebral column height. IVD allow the movement between vertebral bodies and transmit the forces and the basis for locomotion .When the axial compression is greater than interstitial osmotic pressure ,water extrude through the disc wall and result in decrease in the height and total body height .During day ,due to constant force of gravity and muscular activity. This study was to find out whether low intensity exercise reduces vertebral column height. The low intensity exercise was 20 min jogging in the ground. The C7 and S2 spinous process were palpated and marked with a dot on the skin over the middle of the spinous process of 20 asymptomatic subjects of age group 18-21. It was measured before running and recorded vertebral column height. The subjects were allowed to run for 20 minutes in low intensity. Following the run, the subjects were aligned to palpate the C7 and S2 spinous process and the second vertebral column height measurement was taken. Height of the subject also measured prior and after the exercises by using stadiometer. This study shows that there is significant height difference ($p<0.05$) and also significant change in Vertebral Column Height / Trunk height ($P = 0.004$) after low intensity exercise. This study concludes that there is statistically significant reduction in vertebral column height after low intensity exercises, which have a high clinical relevance.

Keywords:- *Vertebral Column Height, Intervertebral Disc, Youngs, Height, Loading Response, Low Intensity Exercise.*

I. INTRODUCTION

The vertebral column is the most central body component. Without it cabt stabilize the trunkin upright and perform many complex functions. A healthy spine can optimize the energy transmission in body and perform ADLs with ease and comfort.

Intervertebral discs (IVD) are the connection between two adjacent vertebras .It consist mainly of 3 parts; (i) Nucleus pulposus: the abundant mucopolysaccharide in it helps in spinal mobility by deforming and under axial loading alter the integrity of the disc, (ii) Annulus fibrosis: because of its high collagen content it act as load bearing structure, and (iii) The vertebral end plates: can tolerate high compressive forces. IVD's contribute one fourth of the total vertebral column height (VCH).[1,2]

IVD allow the movement between vertebral bodies and transmit the forces and the basis for locomotion .When the axial compression is greater than interstitial osmotic pressure, water extrude through the disc wall and result in decrease in the height and total body height. During day, due to constant force of gravity and muscular activity, IVD loses its height and when the person is recumbent water imbibed to the nucleus pulposus to restore the height. Dynamic load shrinks the IVD most than static load.[3,4]

The nature of IV discs varies according to the body positions, activities and also has an gender differences. These are specialized pads that separate adjacent vertebrae. And it is responsible for shock absorption and spinal flexibility. Average total disc length will be quarter the length of spinal column 4.50" to 6" (12 to 15 cm) for a good number people. Overall height of the subject depend on the thickness of discs and thereby the spinal column height.[5]

IVD are composed of water, and when the discs squeeze beyond a definite stress, they will give away water through the disc barrier The outcome is a failure in disc height and volume, and therefore a trivial change in overall height, as intervertebral discs put together one-third of the summit of spinal column.

Even though everyone's vertebral column height decreases all the way through the day, running speeds up the tempo of shrinkage for the reason that the discs compress drastically more under the strength of stride. Studies establish that running for 30 minutes at modest concentration decreases disc height by about 6.3%.[6] All disc in the inferior spine is about seven to 10 millimeters bulky, so if we implicit each disc was that broad (an openhanded postulation, as standard discs get as diminutive as three millimeters higher up) that's a utmost about 10 to 15 millimeters off of height following a half-hour jog on the treadmill. Since it is proven that moderate intensity running decreases the height of the vertebral column,[7] we are trying to find out whether low intensity exercise do any role in reduction of vertebral column height.

II. OBJECTIVE

Objective of the study is to find out whether low intensity exercise affect vertebral column height and thus to determine whether low intensity exercise is preferable for patients suffering from spinal segment diseases.

ISSN No:-2456-2165

III. METHODOLOGY

➢ *Sampling:*

The participants in the study were college students of age between 18-21 years of both sexes. The design of the study was pre-post interventional study. And the sampling technique we administered was purposive sampling. Subjects with scoliosis, limb length discrepancy were excluded from the study.

➢ *Test Procedure:*

The study utilized a pretest / post test to determine if there is any relation between low intensity exercise and vertebral column height. The low intensity exercise was 20 min jogging in the ground with the guidance and supervision of qualified physiotherapists. The C7 and S2 spinous process were palpated and marked with a dot on the skin over the middle of the spinous process of 20 asymptomatic subjects of age group 18-21. It was measured before running and recorded vertebral column height. The subjects were allowed to run for 20 minutes in low intensity. Following the run, the subjects were aligned to palpate the C7 and S2 spinous process and the second vertebral column height measurement was taken. Height of the subject also measured prior and after the exercises by using stadiometer.[8] To avoid measurement error we done three measurements of each variable by three different evaluators and calculated the average value for each variables.

IV. RESULTS

Statistical Analysis: For the descriptive statistics mean and standard deviations were used for age, pre-post pulse rate, pre-post height, and pre-post vertebral column height. Paired sample t test was used to compare the means of height difference and vertebral column height within the group with p value <0.005 considered as statistically significant.

Table 1 shows the descriptive statistics of the subjects participated in the study. The pulse rate of the subject, height and vertebral column height prior to the moderate intensity exercise was 79.50 bpm, 166.35 cm, and 47.15 cm respectively. After the moderate intensity exercise the subjects pulse rate, height and vertebral column height was changed to 98.30 bpm, 164.84 cm and 44.90 cm respectively. The mean difference of height and vertebral column height prior and after to the exercise was 1.51 cm, and 1.25 cm correspondingly.

Variables	Mean ± Std. Dev
Age	19.70 ± 1.25
Pulse pre (bpm)	79.50 ± 4.43
Pulse post (bpm)	98.30 ± 10.06
Height Pre (cm)	166.35 ± 7.30
Height post (cm)	164.84 ± 7.08
Height Difference (cm)	1.51 ± 0.82
Vertebral column height Pre (cm)	47.15 ± 5.43
Vertebral column height Post (cm)	45.85 ± 4.93
Vertebral column height Difference (cm)	1.25 ± 0.98

Table 1:- Descriptive Statistics of the Subjects

Within the group comparison by using paired t test shows significant difference in height (p=0.000) and vertebral column height; this shows statistically significant reduction in height even after the low intensity exercises (0.004).

Variable	Mean ± SD	t value	Sig. (2 –tailed)
Height (Pre – Post)	1.51 ± 0.82	5.84	0.000
Vertebral column height (Pre – Post)	1.30 ± 1.08	3.79	0.004

Table 2:- Paired Sample T Test Comparison within the Group

V. DISCUSSION

The study is initiated to check the effect of low intensity exercises (20 minutes jogging) on vertebral column height. Twenty healthy volunteers participated in this study.

The vertebral column height is measured by noting the distance in centimeters between C7 and S2 spinous process before and after the exercise. The study shows that there is statistically significant difference in vertebral column height after a low intensity exercise, which is clinically relevant when considering the exercise prescription of an IVDP patient.

The loss of vertebral column height is a well documented phenomenon in literature. The reason behind the loss over 24 hours are fluid loss due to reduce disk volume, radial bulging of annular fibers, bulging of vertebral end plates into vertebral body and enhance in lordosis. In most of the studies the vertebral column height is checked after a sternous exercise (one hour running, static

loading for 3-4 hours etc.) all the studies have proved that the VC height reduces by 1.2- 1.5 mm.[9,10,11]

The nucleus pulposus has been habitually likened to a water balloon. When compacted it deforms, and increased pressure stretches the stockade of the balloon in all directions. Under compressive loading the pressure is exercise in all directions as the nucleus pulposus endeavor to expand. Stress in the annulus fibrosus rises as an upshot of the nuclear pressure. A force equal in enormity but opposite in course are exerted by the annulus fibrosus on the nucleus pulposus, which hold back radial spreading out of the nucleus pulposus and ascertains stability. The nuclear pressure is broadcast by the annulus fibrosus to the end plates. At some stage in non-weight bearing actions (like sleeping) the discs enlarge as they saturate up fluid, mounting the length of the spine by as much as an inch during the night.[12] However, the drag of gravity for the duration of the day fallout in compression weariness that causes the common adult drop an inch in height each day principally as fluid is squeezed out of the spinal discs (this turn around during sleep).

It is assumed that this reduction of fluids is caused by a decline of osmolality within the disk due to proteoglycan depletion. Under overweight, the IVD distorts, the hydrostatic pressure contained by the disc increases and fluid is squeezed out of the disc gradually. The failures of fluid augment the disc proteoglycans absorption and the predetermined charge density and results in a advanced osmolality and a subordinate pH. Loading have an effect on the IVD cell metabolism and providence directly and indirectly. The undeviating mechanical stimulation applied to the matrix results in cell and nucleus deformation, cell volume revolutionizes, cell membranes extend, cytoskeletal strain and distorted polarization. The augmented intercellular osmolality illustrates water out of the cells and the cell volume is condensed. Therefore, loading alters the physical situation of the disc matrix, which leads to adjust in the water and chemical composition of the cell and its volume. These all may throw in the intervertebral disc reduction after low intensity exercises for 20 minutes.

Present study aims to find out whether a low intensity exercise too makes such changes and found that it affects same as moderate intensity. The reason behind it can be the short term nature of the spine loading. It has been proved that the radial bulging occurs after the load is applied and the creep mechanism following loading takes time, reason being the biochemical composition of annular fibers. The fluid in the disk also won't gain or lost over a short period of time. Our findings are supported by the study conducted by M. Kordi et al on the disk height in bed ridden patients using MRI.[13]They have found that the immediately following bed rest there is no change in vertebral disk height and the height increased only after 3-6 months of bed rest.

VI. CONCLUSION

This study concludes that there is statistically significant reduction in vertebral column height after low intensity exercises, which have a high clinical relevance. We also recommend conducting this study in large population to find out clinical correlations.

ACKNOWLEDGMENTS

The authors thank the students of Sree Anjaneya College of Paramedical Sciences, the physiotherapy faculties for their assistance and support with this research.

CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.
Ethical Approval: The study was reviewed and approved by institutional ethical committee.

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