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RESEARCH PAPER

CARDIOPULMONARY ADAPTATION TO 6-WEEKS SKIN TRACTION AND ISOMETRIC EXERCISE AMONG NIGERIAN SUBJECTS WITH LUMBAR SPONDYLOSIS

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ABSTRACT

Traction is widely use for the treatment of spinal conditions in orthopaedics, but its effects on pain relief and cardiopulmonary functions has not fully been investigated. The purpose of this study was to determine the cardiopulmonary adaptation to 6-weeks skin traction and isometric exercise in patients presenting with lumbar spondylosis. The study was a pretest-posttest experimental design. A total of 27 subjects (21 males and 6 females) clinically diagnosed with lumbar spondylosis were recruited for the study. Subjects received skin traction 5 kg on each lower limb with the 'head' of the bed lowered by five degree and isometric exercise for a period of 6 weeks. Subjects' pre and post treatment systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate (PR), vital capacity (VC), peak expiratory flow rate (PEFR) and pain level was assessed, while the collected data was analysed using students' t-test. Findings of the study revealed significant difference in DBP, PR, VC, PEFR ($p < 0.05$), but no significant difference in SBP ($p > 0.05$). 6-weeks skin traction resulted in a significant change in DBP, PR, VC and PEFR in patients with chronic lumbar spondylosis.

Keywords: Skin traction, isometric exercise, lumbar spondylosis, cardiopulmonary functions.

INTRODUCTION

Traction involves the application of both manual and mechanical forces to adjacent body parts away from each other in order to decompress irritated tissues, realign body parts, and relax tight structures (Sunder, 2003). The different methods of administering traction therapy include: continuous traction, sustained traction, intermittent traction and rhythmic traction. Skin traction is a form of continuous traction. It involves the application of light weight for prolonged period of time, usually between 3 to 6 weeks, while the patient is on bed rest and his/her head tilted slightly downwards to about 5^o (Ebnezar, 2003). The patient is usually asked to carry out isometric quadriceps exercise throughout the duration of the traction. Traction could improve signs and symptoms by both biomechanical effect, such as separation of the intervertebral motion segment (Twomey, 1985), and neurophysiological effects such as modulation of nociceptive input in either the ascending or descending pathways (Zusman, 1986).

The cardiopulmonary complications of prolonged immobilization include: orthostatic hypotension, reduction of blood plasma volume, reduction of cardiovascular performance, thromboembolic phenomena, cardiovascular deconditioning, increased mechanical resistance to breathing, reduced cough and bronchial ciliary activity, reduced tidal volume, hypostatic pneumonia and pulmonary embolism (Brooks et al., 2000; Canon and O' Gara, 2001; Fortrat et al., 2001; Sunder, 2003; Foutz *et al*., 2007).

The different results from trials of traction have furnished conflicting evidence for the efficacy of traction and this has been further interpreted in clinical guidelines to mean that traction is an ineffective modality for the management of lumbar spine conditions (New Zealand Ministry of Health, 1997; Krause et al., 2000). According to Twomey, 1985; Lee and Evans (1992) there is evidence to suggest that even a small doze of traction weight provides a mechanical effect. The maximum weight that can be applied through skin traction is 15 Ibs or 6.7 kg. According to Nwuga (1990), this weight is not enough to distract the spinal vertebra Ebnezar (2003) also noted that a force which is equal to 50% of the body weight is required to distract the spine. This is higher than the weight usually applied in skin traction.

Spondylosis also known as wear and tear of the spine is a degenerative condition of the intervertebral disc. The first sign of spondylosis often present clinically at about the age 30, but 45 is a more common age. Spines that show indications of spondylosis also often show osteoarthritic changes in the corresponding facet joints. Spondylosis usually results in a decrease in disc height which in turn leads to dramatic increase in loads on the facet joints. Osteophytes form at the margins of the articular surfaces of the facet joints and these, together with the capsular thickening, can cause pressure on the nerve root and reduce the lumen of the intervertebral foramen. Usually, pain starts as a niggle and later becomes constant (Nwuga, 1990; Porter, 2005).

Isometric exercises are commonly performed in the early phase of rehabilitation when a joint is immobilized for a period of time. Research studies have shown that isometric exercise tends to produce a spike in systolic blood pressure that can result in potentially life threatening cardiovascular accidents (Brook et al., 2000; McArdle et al., 2000; Prentice, 2006; Hoeger, & Hoeger, 2007). Owen et al. (2010) in their research work noted that isometric exercise of less than one hour per week resulted in a reduction in systolic and diastolic blood pressure. The response of cardiovascular functions to skin traction has not been investigated in any great depth. Therefore, there is a need to investigate the cardiovascular (blood pressure and pulse rate) adaptation to 6-week skin traction in patients with lumbar spondylosis at Hilltop Orthopaedic Clinic, Enugu considering the numerous possible health implications of immobilization and skin traction.

MATERIALS AND METHODS

Study design: In the present study, a repeated measure (pretest-posttest) design was used to determine the effect of skin traction and isometric exercise on lumber spondilosis pain.

Materials: Skin traction kit. The traction kit comprised of adhesive plaster, bandage, calibrated weights (5 kg for each lower limb) and pulley system. It was prescribed by the clinic doctors and administered by the plaster technician (attendant) with the clinic. Aneroid sphygmomanometer, model JD 1005, standard CE 0483 made in China by Wenzhou Jianda Medical Instrument Co. Ltd., used in measuring the subjects' blood pressure. A Litman model stethoscope, model classic II SE made in China, used with the sphygmomanometer in measuring the subjects' blood pressure. Stop watch model KD 1069, made in China, used for timing the pulse rate measurements.

Subjects: The population for the study was subjects with the diagnosis of lumbar spondylosis attending the Hilltop Orthopaedic Clinic, Enugu, Nigeria. Twenty-seven subjects (21 males and 6 females) of black African origin that met the inclusion criterials were recruited for the study. The subject's age ranged from 48 years to 64 years.

Ethical Consideration: Ethical clearance was obtained from the Health Research and Ethics Committee of the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu State. Permission was also obtained from the management of the hospital, while the subjects' informed consent was duly obtained prior to the study.

Inclusion criteria: Only those who volunteered to participate in the study were recruited. Subjects with chronic (pain > 3months) moderate to severe lumber pain secondary to spondylosis were selected and were of black African (Nigerian) origin. Subjects on similar analgesics (acetamino-phen, acetysalicylic acids, Acetic acids & propionic acids) were also recruited.

Exclusion criteria: All patients with diagnosis of cardiovascular and pulmonary diseases such as high blood pressure, cardiac conditions, asthma, bronchitis, pneumonia, those suffering from spondylolisthesis, diseases of the spinal cord, pott's diseases, neurological and metabolic diseases such as diabetes and neuropathies were all exempted from the study. Those on other forms of therapy except and analgesics mentioned above were also excluded.

Treatment procedure: The ethical approval of the Research and Ethics committee of University of Nigeria Teaching Hospital, Enugu and permission from Medical Director, Hilltop Orthopaedic Clinic were sought and obtained, while the individual patients' informed consent was duly obtained before their participation. The subjects maintained supine lying with the lower limbs placed on pillow throughout the period of 6-weeks. The subjects carried out isometric exercise, under the instruction of a physiotherapist, three times daily for the period of 6-weeks. This was done 20 times three times a day (morning, afternoon and evening) for the period of 6-weeks. The 20 sustained contractions were divided into two stages of 10 sustained contractions with 3minutes rest in between the stages. The vital capacity (VC) and Peak expiratory flow rate (PEFR) of all the patients were measured on the first day of admission and at the end of the traction treatment (42^{nd} day) using spirometer (Schiller, Sp-1, model 05732, made in Germany) and peak flow meter (CE 0318, made in Spain). The patients carried out the procedures in supine lying (i.e., lying on the back) while the traction weight remained in place. The patients' head was supported on a soft pillow of about 10cm thickness.

Vital Capacity: The subjects held the spirometer with a disposable mouth piece attached to it on their right hand. The patients on instruction carried out deep breathing exercise (full lungs inhalation and total exhalation) five times to enable them relax. They were then instructed to put the mouth piece in their mouth, take a deep breath in as deeply as possible (full inspiration), seal their lips very tight around the mouth piece while pinching the nose with the thumb and index finger of the left hand to prevent escape of air. They were asked to expire smoothly and completely all the air in their lungs.

Peak expiratory flow rate: The subjects held the peak flow meter with a disposable mouth piece attached to it on the right hand. They were asked to do deep breathing exercises five times to enable them relax. They were then instructed to put the mouth piece in their mouth, take a deep breath in as deeply as possible (full inspiration), seal their lips very tight around the mouth piece and expire as forcefully and rapidly as possible into the peak flow meter. For each procedure (both VC and PEFR) the subjects rehearsed the procedures properly before the actual measurement was taken. They carried out the procedure for three times with five minutes' rest between each manoeuvre. Each procedure was taken three times and the highest volume recorded. The PEF meter was calibrated while the spirometer generated its readings electronically.

Pain: Pain levels on admission to the study were assessed using the 10 Point Numerical Pain Rating Scale. This involved semi objective measurement of the subjects' level of pain ranging from zero (no pain perception) to ten (worst/maximum pain perceived) (Jaques, 2009). All subjects were on analgesics (aspirin, 325-650 mg, 4 hourly; diclofenac 50-200 mg trice daily; ibuprofen, 600- 800 mg 4 hourly) as prescribed by the orthopaedic surgeons. Post-tests pain assessment was also conducted as in the pre-test procedure using the 10-point Numerical Pain. The subjects discontinued drugs at the end of 6 weeks (42^{nd} day), while the pain levels were reassessed on the 45^{th} day when the subjects resumed standing and ambulatory exercises.

Statistical analysis: The data collected was analysed using inferential statistics. Paired t- test was used to find the differences between pre and post treatment measurements of pain levels. All statistical analysis was performed on a Toshiba compatible microcomputer using the statistical package for the social science (SPSS), (Version 16.0 Chicago IL, USA). The probability level for all the above tests was set at p= 0.05 to indicate significance.

RESULTS

The Age, weight, Height, Systolic Blood Pressure and Diastolic blood pressure of the subjects are presented in table 1 with all values expressed as Mean ± Standard Deviation.

Table 1: Physical Characteristics of Subjects (n = 27)

Variables	**Mean ± SD**
Age (years)	58.63 ± 7.22
Weight (kg)	54.89 ± 5.13
Height (Meters)	1.73 ± 6.97
SBP (mmHg)	122.44 ± 9.34
DBP (mmHg)	75.19 ± 5.74

Table 2: Pre and post treatment measurements of the subjects' resting SBP (n =27).

Pre and post measurements	$\bar{X}$ ± SD	SE	t-value	t-crit.	Decision
Pretest	122.8 ± 9.10	1.75			
Postest	123.3 ± 6.82	1.31	.444	2.056	NS

Df = 26, NS= not significant.

Table 2 shows the t-test for SBP of the subjects. The pre and post-treatment mean and standard deviation values were 122.8 ± 9.10 and123.3 ± 6.82. Standard errors of mean were 1.75, 1.31 from pre and post treatment measurements, t- value .444and t- critical 2.056 respectively. The t-value (.444) calculated is less than the t-critical (2.056), this implies that there was no significant change in SBP among the subjects who received 6-week skin traction and isometric exercise (p > 0.05).

Table 3: Pre and post treatment measurements of the subjects' resting DBP (N=27).

Pre and post measurements	$\bar{X}$ ± SD	SE	t-value	t-crit.	Decision
Pretest	75.2 ± 5.74	1.11			
Posttest	74.2 ± 5.98	1.15	2.565	2.056	S

Df= 26, S= significant.

Table 2 shows the t-test for DBP of the subjects. The pre treatment and post-treatment mean and standard deviation values were 75.2 ± 5.74 and 74.2 ± 5.98. Standard errors of mean are1.11 and 1.15 from pre and post treatment measurements, t-value 2.565 while, the t-critical was 2.056. The t-value (2.565) calculated is greater than the t-critical (2.056), this implies that there was significant change in DBP among the subjects who received 6-week skin traction and isometric exercise (p < 0.05).

Table 4: Pre and post treatment measurements of the subjects' resting PR (N=27).

Pre and post measurements	$\bar{X}$ ± SD	SE	t-value	t-crit.	Decision
Pretest	72.9 ± 3.06	0.59			
Posttest	79.5 ± 3.74	0.72	12.460	2.056	S

Df= 26, S= significant.

Table 4 shows the t-test for PR of the subjects. The pre-treatment and post-treatment mean and standard deviation values were 72.9 ± 3.06 and 79.5 ± 3.74. Standard errors of mean were 0.59 and 0.72 from pre and post treatment measurements, t-value 12.460 while, the t-crit.was 2.056. The t-value (12.460) calculated is greater than the t-critical (2.056), his implies that there was a significant change in PR among the subjects who received 6-week skin traction and isometric exercise (p < 0.05).

Table 5: Pre and post treatment measurements of the subjects' VC (N=27).

Pre and post measurements	$\bar{X}$ ± SD	SE	t-value	t-crit.	Decision
Pretest	4.4 ± 0.29	0.55			
Posttest	4.2 ± 0.26	0.49	9.125	2.056	S

Df= 26, S= significant.

Table 5 shows the t-test for VC of the subjects. The pre-treatment and post-treatment mean and standard deviation values were 4.41±_0.29 and 4.20 ± 0.26. Standard errors of mean were 0.55 and 0.49 from pre and post treatment measurements, t-value 9.125 while the t-critical was 2.056. The t-value (9.125) calculated is greater than the t-critical (2.056), this implies that there was a significant change in VC among the subjects who received 6-week skin traction and isometric exercise ($p < 0.05$).

Table 6: Pre and post treatment measurements of the subjects' PEFR (N=27).

Pre and post measurements	$\bar{X}$ ± SD	SE	t-value	t-crit.	Decision
Pretest	467.4 ± 31.76	6.11			
Posttest	443.5 ± 27.52	5.30	7.136	2.056	S

Df= 26, S= significant.

Table 6 shows the t-test for PEFR of the subjects. The pre-treatment and post-treatment mean and standard deviation values were 467.4 ± 31.76 and 443.5 ± 27.52. Standard errors of mean were 6.11and 5.30 from pre and post treatment measurements; t- value 7.136 while, the t-critical was 2.056. This implies that there was a significant change in PEFR among the subjects who received 6-week skin traction and isometric exercise ($p < 0.05$).

DISCUSSION

There is paucity of literature on the effects of skin traction on cardiopulmonary functions among black African subjects with lumbar spondylosis. Result of the present study showed that there was a significant reduction in diastolic pressure, vital capacity, peak expiratory flow rate and significant increase in pulse rate, but no significant difference in systolic blood pressure. A study conducted by Owen *et al*., (2010) on effect of isometric exercise on resting blood pressure: a meta-analysis. Partly agreed with the findings of this study. In their study five trials were identified including a total of 122 subjects. Isometric exercise for less than one hour per week reduced systolic blood pressure by 10.4 mm Hg and diastolic blood pressure by 6.7 mm Hg. Their findings did not agree with the results on SBP but agreed with that of DBP. However, their methodology was also different from the methods used in this study.

Akinbo *et.al*. (2006) studied the effect of cervical traction on cardiovascular and selected ECG variables of cervical spondylosis patients using various weights. Sixty out of 78 subjects participated in the study. They were randomly assigned into three experimental groups A, B and C. Their systolic and diastolic blood pressures (SBP and DBP) and heart rates (HR) were measured. Rate pressure product (RPP) was calculated using standard equation18 and ECG recorded using the KENZ, 201machine. Subjects' cardiovascular and ECG responses were monitored in a supine resting position (baseline) and under three experimental conditions using the subjects' 7.5% kg total body weights (TBW), 10% kg TBW and 15% TBW at different time intervals (5, 10 and 15 minutes respectively). Compared with the baseline values, there was a drop in SBP, DBP and RPP for all subjects in the three groups. The SBP, DBP and RPP alteration were not significant for the 7.5% TBW CT, but significant ($p < 0.05$) for the 10% and 15% TBW tractions. The HR and ECG variables revealed no significant difference in all the groups.

This current study did not fully agree with the study by Akinbo *et al.* (2006) Though their methodology was different from the method used in this study: their time of treatment was very short (5, 10 and 15minutes) for the different groups, they applied different traction weights for different groups while their subjects did not carry out isometric exercise. The traction weight applied in this study was 5kg on each lower limb for a period of 6 weeks. This current study showed there was no significant difference in SDP but significant difference in DBP, PR, VC, PEFR and pain level.

Michael *et al*. (2005) assessed the effects of bed rest deconditioning on vascular dimension and function of leg conduit arteries and the effectiveness of resistive vibration exercise as a countermeasure for vascular deconditioning during bed rest. Sixteen healthy men were randomly assigned to bed rest (BR-Ctrl) or to bed rest with resistive vibration exercise (BR-RVE). Before and after 25 and 52 days of strict horizontal bed rest, arterial diameter, blood flow, flow-mediated dilatation (FMD), and nitroglycerin-mediated dilatation were measured by echo Doppler ultrasound. In the BR-Ctrl group, the diameter of the common femoral artery decreased by 13 - 3% after 25 and 17 - 1% after 52 days of bed rest ($P = 0.001$). In the BR-RVE group this decrease in diameter was significantly attenuated (5 - 2% after 25 days and 6 - 2% after 52 days, *P* - 0.01 vs. BR-Ctrl). Baseline blood flow did not change after bed rest in either group. After 52 days of bed rest, FMD and nitroglycerin mediated dilatation of the superficial femoral artery were increased in both groups, possibly by increased nitric oxide sensitivity. During the bed rest period, resting heart rate increased significantly in the BR-Ctrl group (*P* - 0.05). Changes in heart rate during bed rest were significantly different between the BR-Ctrl and BR-RVE groups, and heart rate was significantly lower in the BR-RVE group compared with the BR-Ctrl group at BR25 and BR52 (*P* - 0.05). Blood pressure did not change significantly during bed rest and was not different between the groups. The above study by Michael *et al.* (2005) also did not fully agree with the results of this study. Their method was different from that used in this study. Their findings on HR and SBP agreed with the findings of this study but not on DBP.

Smorawinski *et al*. (2001) conducted a study on the effects of 3-day bed rest on physiological responses to graded exercise in athletes and sedentary men. Twelve sedentary men and 10 endurance- and 10 strength-trained athletes were submitted to 3-day BR. Before and after BR they performed incremental exercise test until volitional exhaustion. Respiratory gas exchange and heart rate (HR) were recorded continuously, and stroke volume (SV) was measured at submaximal loads. Blood was taken for lactate concentration (LA), epinephrine concentration (Epi), norepinephrine concentration (NE), plasma renin activity (PRA), human growth hormone concentration (hGH), testosterone, and cortisol determination. Reduction of peak oxygen uptake ($V\mathbf{o}_{2\,\text{peak}}$) after BR was greater in the endurance athletes than in the remaining groups (17 vs. 10%). Decrements in $V\mathbf{o}_{2\,\text{peak}}$ correlated positively with the initial values ($\boldsymbol{r} = 0.73$, $\boldsymbol{P} < 0.001$). Resting and exercise respiratory exchange ratios were increased in athletes. Cardiac output was unchanged by BR in all groups, but exercise HR was increased and SV diminished in the sedentary subjects. The submaximal (LA) and (LA) thresholds were decreased in the endurance athletes from 71 to 60% $V\mathbf{o}_{2\,\text{peak}}$ ($\boldsymbol{P} < 0.001$); they also had an earlier increase in (NE), an attenuated increase in (hGH), and accentuated PRA and cortisol elevations during exercise. These effects were insignificant in the remaining subjects. The above study by Smorawinski *et al*. (2001) agreed with the result of this study on significant difference in the subjects' PR though, their method was also different from that used in this study. Their study lasted only 3 days while their subjects did not carry out isometric quadriceps exercise.

The results of this study are in agreement with the study conducted by Schafermeyer *et al.* (1991) on respiratory effects of spinal immobilization in children in North Carolina. The study was conducted to assess the restrictive effects of two spinal immobilization strapping techniques on the respiratory capacity of normal, healthy children. Fifty-one healthy children 6 to 15 years old participated in the study. The participants' forced vital capacity (FVC) measurements were first obtained with children standing and lying supine and then in full spinal immobilization using two different strapping configurations, cross straps and lateral straps. Straps were tightened to allow one hand to fit snugly between the strap and child. The results showed that supine FVC was less than upright FVC (P less than .001). FVC in spinal immobilization ranged from 41% to 96% of supine FVC (80 +/- 9%). There was no difference in FVCs between strapping techniques (P = .83). However, the methods used by Schafermeyer *et al*. (1991) in their study varied from that used in this study.

The results of this study are also in agreement with the work of Totten and Sugarman (1999) who evaluated the effect of whole-body spinal immobilization on respiration in United States of America. Their study was a randomized, crossover laboratory study with 39 human volunteer subjects (20 males; 19 females) ranging in age from 7 to 85 years. Respiratory function was measured three times: at baseline (seated or lying), immobilized with a Philadelphia collar on a hard wooden backboard, and on a Scandinavian vacuum mattress with a vacuum collar. The comfort levels of each of the two methods were assessed on a forced Likert scale. Results showed that both immobilization methods restricted respiration, 15% on the average. The effects were similar under the two immobilization conditions, although the FEV1 was lower on the vacuum mattress. Respiratory restriction was more pronounced at the extremes of age. The vacuum mattress was significantly more comfortable.

The results of this study are also in agreement with the work of Didem *et al*. (2011) who conducted a cross-over trial in healthy 60 volunteer subjects. They performed a full spirometry in the supine position: forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and FEV1/FVC were recorded in all subjects. Then, Philadelphia type cervical collar (Philly) and Kendrick extrication device (KED) were applied to all subjects. They measured FVC, FEV1, FEV1/FVC in all subjects in the supine position at the 5th and 30th minutes after application of cervical collar and KED. After a one-hour relaxation period, Philly and long spinal backboard with straps were applied to all subjects. FVC, FEV1, FEV1/FVC were measured again in all subjects at the 5th and 30th minutes after application of cervical collar and long spinal backboard. The results showed that significant decreases were determined in FEV1 ($p = 0.000$) and FVC levels ($p = 0.000$) after application of KED, but there were no significant differences in FEV1/FVC levels. After application of the long spinal backboard, a comparison of baseline levels and levels at the 5th and 30th minutes demonstrated statistically significant decreases in FEV1 ($p = 0.000$) and FVC levels ($p = 0.000$), but no significant difference in FEV1/FVC levels.

CONCLUSION

From the results obtained in this study, it was concluded that 6-weeks skin traction with isometric exercise will result in a significant change DBP, PR, VC, PEFR and among black African origin with lumber spondylosis. Patients undergoing skin traction treatment should carryout respiratory exercises to prevent decrease in VC and PEFR.

PRACTICAL APPLICATION

Medical practitioners should intensify the use of skin traction in the management of chronic severe lumber spondilosis pain and should always include lower limbs isometric exercise not lower than 20 contractions 3 times daily in the treatment. Further studies are being recommended on varied traction weight and the number of daily isometric contractions. Randomized controlled trials are also recommended

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REFERENCES

Akinbo, S.R., Noronha, C.C., Oke, D.A., Okanlawon, A.O. and Danesi, M.A. (2006). Effect of cervical traction on cardiovascular and selected ECG variables of cervical spondylosis patients using various weights. *Niger Postgrad Med Journal*; 13(2): 81-88.

Brook, G.A., Fahey, T.D., White, T.P. and Baldwin, K.M. (2000). Exercise Physiology: Human bioenergetics and its applications (3rd ed) London: McGraw Hill. Pg 432.

Canon, C.P. and O' Gara, P.T. (2001). Critical Pathways in Cardiology. Lippincott: Williams and Wilkins Publishers. Pg 50.

Didem, A.Y., Can, A., Sabiha, Y., Sezgin, S., Aslı, Ç. and Emine, S.Ö. (2011). Effects of spinal immobilization devices on pulmonary function in healthy volunteer individual's *Turkish Journal of Trauma & Emergency Surgery*; 17 (2):103-107

Ebnezar, J. (2003). Essentials of orthopaedics for physiotherapists (2nd ed) New Delhi: Jaypee Brothers Medical Publishers (P) Ltd., Pg 134.

Fortrat, J.O., Sigaudo, D., Hughson, R.L., Maillet, A., Yamamoto, Y. and Gharib, C. (2001). Effect of prolonged head-down bed rest on complex cardiovascular dynamics. *Autonomic neuroscience basic clinical*; 86 (3): 192-201.

Foutz T, Ratterman A, Halper J. (2007) Effects of immobilization on the biomechanical properties of the broiler tibia and gastrocnemius tendon. *Poultry science*, 86: 931-936.

Hoeger, W.W.K. and Hoeger, S.A. (2007). Lifetime physical fitness and wellness: A personalised program (9th ed) Australia: Thomson Wadsworth, Pg 120.

Jacques, E. (2011). Numerical rating pain scale: A Pain Assessment Tool for the Person in Pain 2009; Available at http://www. about.com. Accessed on 20th May, 2011.

Krause, M., Refshauge, K.M., Dessen, M. and Boland, R. (2000). Lumbar spine traction:evaluation of effects and recommended application for treatment. *Manual Therapy*; 5 (2), 72-81.

Lee, R.Y.W. and Evans, J. (1992). Load-displacement-time characteristics of the spine under posteroanterior mobilisation. *Australian Journal of Physiotherapy*; 38: 115-123.

McArdle, W.D., Katch, F.I. and Katch, V.L. (2000). Essentials of exercise Physiology (2nd ed) London: Lippincott, William and Wilkins, Pg 85.

Michiel, W. P. B., De Groot, P.C.E., Rongen, G.A., Rittweger, J., Felsenberg, D., Smits, P. and Hopman, M.T.E. (2005). Vascular adaptation to deconditioning and the effect of an exercise countermeasure: results of the Berlin bed rest study. *J Appl Physiol*; 99: 1293–1300.

New Zealand Ministry of Health (1997). Acute Low back pain Guide. National Health Committee. Wellington, Pg 241.
Nwuga VC.B. (1990) Manual treatment of back pain. Nigeria: Shaneson C.I. limited, Pg 14-166.

Owen, A., Wiles, J. and Swaine, I. (2010) Effect of isometric exercise on resting blood pressure: a meta-analysis. *Journal of Human Hypertension*; *24*: 796-800.

Porter, S B. (2005). Tidy's physiotherapy (13th ed) India: Butterworth-Heinemann, Pg 232.

Prentice, W.E. (2006). Arnheim's principles of Athletic Training: A competency Based Approach. 12th ed. Boston, McGraw Hill, Pg 442.

Schafermeyer, R.W., Ribbeck, B.M., Gaskins, J., Thomason, S. and Harlan, M. (1991). Attkisson A. Respiratory effects of spinal immobilization in children. *Ann Emerg Med*; 20 (9): 1017-1019

Smorawinski, N, Kaciuba-Uscilko, K, Cybulski, K, Bicz, G. (2001) Effects of 3-day bed rest on physiological responses to graded exercise in athletes and sedentary men. *Journal of Applied Physiology,* 9 (1): 249-257.

Sunder S. (2003) Textbook of rehabilitation. New Delhi. Jaypee Brothers, Pg 79.

Totten, V.Y, and Sugarman D.B. (1999) Respiratory effects of spinal immobilization. *Prehosp Emerg Care*; 3 (4): 347-52

Twomey, L.T. (1985) Sustained lumbar traction. An experimental study of long spine segments. *Spine*; 10: 146-149.

Zusman, M. (1986). The absolute visual analogue scale as a measure of pain intensity. *Australian Journal of Physiotherapy*, 32: 244-246.

AUTHORS CONTRIBUTIONS

Ezema CI and Maximin – Agha E. **were** responsible for the design of the study and gathering of literature materials, **Ezema CI.,** Maximin – Agha E.; Mong, E.U. and Ekezie U. were responsible for the review of literature, drafting of the manuscript, analysis of the data and presentation of the data; **Ezema CI was responsible for** collection of data, Maximin – Agha E. and Mong, E.U. supervised the research work. All the authors read the manuscript.
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