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EFFICACY OF KRAUS-WEBER EXERCISE PROTOCOL IN THE MANAGEMENT OF CHRONIC MECHANICAL LOW BACK PAIN

T. K. Hamzat, Ph.D.; O. E. Awolola, M.Sc.; A. F. Adeniyi, M.Sc.; O. A. Olaleye, M.Sc.

الهدف – تهدف هذه الدراسة لتقصي فاعلية تمارين كروس – ويبر في معالجة آلام أسفل الظهر الميكانيكية المزمنة التصميم – استخدم تصميم التجارب للمجموعات المماثلة في هذه الدراسة . حجم العينة واختيارها – شارك مع متطوع ممن شخصت حالاتهم على أنها آلام أسفل الظهر الميكانيكية المزمنة في هذه الدراسة وقد استخدم أسلوب العينات العشوائية البسيطة «صحن الأسماك» لتوزيع عناصر التجربة إلى مجموعتي التدخل والتحكم . التدخلات – ثم تقصي كل من كثافة الألم ومرونة الجزء القطني من العمود الفقري ومستوى الثقة في القدرات الوظيفية قبل وبعد ٦ أسابيع من العلاج حيث عولجت عناصر مجموعة التدخل باستخدام تمارين كروس ويبر والمعالجة بالحرارة والدلك والإرشاد عن رعاية الظهر أما عناصر مجموعة التحكم فلم تطبق معهم تمارين كروس ويبر ، ثم حللت البيانات التي تم جمعها بواسطة – الإحصاء الوصفي والإحصاء الاستدلالي ومعامل الترابط التسلسلي «سيبرمان» لدى مستوى ثقة ٠,٠٥ ٪ . النتائج أظهرت النتائج التي تم الحصول عليها عدم وجود فارق مجدي بين خصائص ما قبل التدخلات لمجموعة الدراسة وقد حدث تدني كبير بعد التدخل في مستوى الثقة في القدرات الوظيفية وفاقت مجموعة التجربة مجموعة التحكم في ذلك وظهر بأن مستوى الثقة للقدرات الوظيفية يزداد يرتفع مع زيادة كثافة الألم لديهم . الخلاصة – تمارين كروس –ويبر وسيلة فاعلة في معالجة الألم أسفل الظهر الميكانيكية المزمنة إذا ما ضمت إلى العلاج بالحرارة والدلك وإرشادات العناية بالظهر ومن ثم يوصى بها لتضاف إلى الطرق العلاجية الأخرى المتبعة في معالجة هذه النوعية من الآلام .

Objective: This study was carried out to determine the efficacy of Kraus-Weber exercises in the management of chronic mechanical low back pain (CMLBP). ***Design:*** The equivalent group experimental design was used in the study. ***Sample Size and Sampling Technique:*** Thirty volunteer participants with diagnosis of CMLBP took part in the study. The fish bowl technique of simple random sampling was used to assign subjects into either the experimental (Kraus-Weber) or control (non-Kraus-Weber) group. ***Interventions:*** Pain intensity, lumbar spine flexibility and functional abilities confidence level (FACL) were assessed before and after 6 weeks of treatment. Subjects in the experimental group were treated using Kraus-Weber exercise, heat therapy, massage and back care education. Subjects in the control group were also treated with heat therapy, massage and back care education excluding Kraus-Weber exercise. Data obtained were analyzed using descriptive statistics and inferential statistics of Student t-test and Spearman rank correlation coefficient (Rho). Significance was set at 0.05 alpha level. ***Results:*** Results obtained showed that there was no significant difference in the pre-treatment parameters of the two groups studied. There was significantly greater reduction in the post-6-weeks treatment pain intensity and significantly higher post-treatment functional abilities confidence level of the experimental than the control group subjects. Patient's abilities confidence level was found to increase as their pain intensity decreased. ***Conclusions:*** Kraus-Weber exercise is an effective tool in the management of CMLBP when combined with heat therapy, massage and back care education. Kraus-Weber exercise in addition to other modalities was therefore recommended in the management of CMLBP .

Key Words: Low back pain, Rehabilitation Physiotherapy, Exercise therapy; Kraus-Weber exercise

INTRODUCTION

Low back pain is a widespread disorder and is as universal as headache[1]. It is one of man's oldest complaints and a common cause of social distress in many populations[2]. It has continually tasked health care providers because quite a sizeable proportion of the population will attend the clinic for back pain treatment at least once in their life time[2]. Muscle weakness and physical limitations are common in patients with low back pain condition[3]. Many Orthopaedists also believe that the prime factors in low back pain syndrome are muscular dysfunction, especially muscular weakness in the abdominal region, and poor joint flexibility in the back and legs[4]. They further claimed that low back pain patients often present with tightness of hamstrings and low back

From the Department of Physiotherapy, College of Medicine, Nigeria.
Address reprint requests to: T. K. Hamzat, Department of Physiotherapy, College of Medicine, U.C.H., P.M.B. 5017 G.P.O. Dugbe, Ibadan, Nigeria, E-mail: talkzat@yahoo. Com

muscle groups, tight hip flexors, weak abdominal and low back muscles[4].

Various combinations of flexibility and strengthening exercises have been successfully employed in relieving pain and symptoms of low back problems in many whose problems are associated with muscular weakness and lack of flexibility[5]. In a study of the intervention preferences of Physiotherapists, about half of those surveyed said that they would use strengthening and flexibility exercises for treating patients with chronic low back pain[6]. However, these therapeutic exercises are hardly ever used as the only intervention modality in the management of low back pain[7]. Low back and abdominal exercise regimes are performed for several reasons, and these include use of such exercises as a tool for management of low back pain, prevention of injury and as a component of fitness programme. The objective of exercise is usually to stress both the damaged and healthy supporting tissues to foster tissue repair, while avoiding further excessive loading which can exacerbate an existing structural weakness[8].

Kraus-Weber exercise protocol is a series of exercises that measure strength and flexibility of the back, abdominal, psoas and hamstring muscles[9]. It has been used to assess spinal muscle strength and flexibility in healthy Nigerian subjects[10-12]. Those authors recommended that Kraus-Weber exercise protocol should be used in treating mechanical low back pain. However there is a dearth of published clinical evidence to support the efficacy of Kraus-Weber exercise in treating low back pain. This study was therefore carried out to determine the appropriateness of Kraus-Weber exercise protocol in the management of chronic mechanical low back pain.

MATERIALS AND METHODS

Subjects:

The participants for this study comprised male and female subjects with chronic mechanical low back pain attending the Physiotherapy out-patient clinic of the Ring Road State Hospital Ibadan, Nigeria. Consecutive non-probability sampling technique was used to recruit subjects for this study. Subjects with referred pain to any part of the body were excluded from the study.

Instruments:

i. *Standiometer:* A health-o-meter brand of the standiometer was used to measure weight and height of subjects in kilograms and meters respectively.

ii. *Visual Analogue Scale:* This was used for subjective pain measurement. This scale is made up of 10cm long piece of light ruler with a mark '0' at one end and mark '10' at the other end. Mark '0' stands for 'no pain at all' and mark '10' stands for the "peak pain"[13].

iii. *Modified Functional Abilities Confidence Scale (MFACS):* This was used to assess the functional abilities confidence level of the subjects. The functional abilities confidence scale is a 15-item scale developed by William and Myers (1998) with ratings from 0% to 100% for each item. It was modified in this study as 0% (not confident at all) , 50% (moderately confident), and 100% (completely confident). The average of all the scores for individual items was taken as the patient's score. A high rating corresponded to good functional status. The scale has a good test-retest reliability (Interclass correlation of 0.94) and high internal consistency as evident by Cronbach's alpha of 0.96[14].

iv. *Stop Watch:* A stop watch (Heuer, Trackmate brand) was used to time the duration of exercise treatment appropriately.

METHODS

Research Design

The research design for this study was the equivalent group experimental design. Subjects were randomly assigned to either the treatment or control groups using the fish bowl technique of simple random sampling. Subjects who picked 'Yes' from the fish bowl were assigned to the experimental group, while subjects who picked 'No' were assigned to the control group. Fifteen subjects were so assigned in the experimental group (KW group) and 15 in the control group (NKW group).

Procedure

Ethical approval was obtained from the joint University of Ibadan/University College Hospital, Ibadan (U.I. / UCH) Institutional Review Committee for this study. The cooperation of attending Orthopaedic Surgeons and Physiotherapists at the Ring Road State Hospital, Ibadan was also sought and obtained. Procedure of the study was explained to participating subjects and their written informed consents were obtained. Clinical information such as: gender, age and onset of back pain were recorded for each subject accordingly. This information is not used for data analysis of this study. The following data were then

collected by one of the authors (Adeniyi) who did not know the aim of the study (blind measurement):

1. Pain Level: The visual analogue scale was used to measure the pain level of subjects. The scale was shown to the subject, who was asked to note his/her present level of pain. Subject's response was then recorded. Mark '10' stands for peak pain intensity while mark '0' stands for no pain[13]. Pain levels were obtained during subsequent forthnight measurements.

2. Modified Fundional Abilities Confidence Level: The Modified Functional Abilities Confidence Scale (MFACS) was used to assess how confident the subject was to carry out his/her functional activities; the average score of the patient was recorded. High scores or rating imply good confidence level while low scores indicate poor confidence level[14]. MFACS readings were obtained during subsequent forthnight measurements.

3. Lumbar Spine Flexibility: The modified Schober technique was used to assess Lumbar spine flexibility. With subject standing erect but relaxed, upper part of the sacrum was identified by the spinal intersection of a horizontal line joining the dimples of Venus and noted as '0'. Two points, 10cm above and 5cm below this spot were marked. Subject on instruction, then bent forward maximally and the distance between the upper and lower marks was measured in centimeters. This measured value minus 15 represents lumbar flexion.

Treatment Procedure: Subject wore a light vest and a pair of shorts to allow for ease of movement when carrying out the exercises. Group A (experimental) was the Kraus-Weber group and group B (control), was the non-Kraus-Weber group. Subjects in group B were treated at each visit with infrared radiation to the low back for 15 minutes and massage of the lower back muscles was subsequently administered using Neurogesic brand of Methyl Salicylate as massage medium. Group A subjects were treated at each visit with; infrared radiation to the low back for 15 minutes, massage of lower back muscles using Neurogesic brand of methyl salicylate as a medium, and Kraus-Weber exercise was then administered one after the other until the 6-items were attempted and completed.

The Kraus Weber exercises[15] are as follows:

i. Exercise of the abdominal and psoas muscles.
Starting Position: Subject was in supine lying with hands behind the neck, and one of the authors (Awolola) held the subject's feet down on the plinth.

Instruction: Subject was instructed to keep his hand behind his neck and try to curl up into sitting position.

ii. Abdominal muscles exercise only.
Starting Position: Subject was in supine position lying with hands behind the neck and knees bent i.e. crook lying. The subject's feet were held down on the plinth.

Instruction: Subject was instructed to keep the hands behind the neck and curl up into sitting position.

iii. Exercise of the psoas and lower abdominal muscles.
Starting Position: Subject was in supine lying on the plinth with hands behind the neck and leg extended.

Instruction: Subject was instructed to lift the feet 25 cm off the pinth, keeping the knees extended maintaining the position for 10 seconds.

iv. Exercise of the upper back muscles.
Starting Position: Subject was in prone lying with a pillow under his abdomen so as to give body a see-saw kind of posture. The subject clasped his hands behind his neck.

Instruction: The feet of the subject were held on the plinth and the subject was instructed to lift his chest, head and shoulders off the plinth and hold the position for 10 seconds.

v. Exercise of the low back muscles.
Starting Position: Subject was in prone lying with a pillow under his abdomen but his hands, on which his head rested, were on the plinth.

Instruction: While holding the subject's chest down on the plinth, the subject was instructed to lift up his legs as far up as possible without bending the knees and remaining in the position for 10 seconds.

vi. Exercise of the back and hamstring muscles.
Starting Position: The subject stood erect, barefooted with hands by the sides.

Instruction: The subject was instructed to keep his feet together, knees straight and lean down forward slowly while trying to touch the floor with his finger tips.

4. Back Care Education: Postural education for standing, sitting and other activities of daily living was subsequently taught to the subjects in both groups. A small handbill describing the precautions to be taken in back usage was given to serve as a reminder for the participants.

The treatment sessions were carried out three times in a week on alternate days for 6 weeks giving a total of 18 sessions. Subjects were reassessed fortnightly blindly and the parameters; pain intensity, lumbar spine flexibility and functional abilities confidence level were recorded accordingly.

RESULTS

Thirty subjects participated in this study. They comprised 5 male and 10 female chronic mechanical low back pain subjects randomly assigned to the experimental group; and 8 male and 7 female chronic mechanical low back pain subjects randomly assigned to the control group.

The physical parameters of the 30 subjects who completed the 6-week treatment programme are presented in Table 1. Comparison of these values using independent t-test analysis showed that there was no significant difference (P>0.05) in each of age, height and weight of the two groups. Comparison of the pre-treatment parameters of subjects using independent t-test (Table 2) showed that there was no significant difference in the mean pre-treatment values of pain intensity and lumbar spine flexibility and functional abilities confidence level (P>0.05) in the 2 groups.

The pre and post mean pain intensity, lumbar spine flexibility and functional abilities confidence (FACL) values of each of the experimental and control groups were compared using paired t-test (Table 3). The analysis showed that there was a significant reduction in pain intensity and significant increase in FACL (P< 0.05) in each of the 2 groups of subjects. There was however no significant difference in the mean lumbar spine flexibility values in either of the experimental or the control group.

Table 1. Physical characteristics of subjects

	KW Group (n=15) $\bar{X}$±S.D	NKW Group (n=15) $\bar{X}$±S.D	t-value	p-value
Age (yrs)	50.47±9.80	53.07±7.94	-0.80	0.43
Weight (kg)	69.87±10.60	73.00±10.62	-0.81	0.43
Height (m)	1.63±0.01	1.66±0.10	-0.93	0.36

Key: KW = Experimental, NKW = Control, t-value = Independent t-test

Table 2. Comparision of pre-treatment parameters of subjects

	KW Group $\bar{X}$±S.D	NKW Group $\bar{X}$±S.D	t-value	p-value
Pain Intensity (0-10 scale)	7.93±2.76	7.33±2.13	0.67	0.51
Lumbar Spine Flexibility (cm)	6.87±13.59	6.19±1.62	1.18	0.25
FACL (0-100 scale)	36.00±6.80	29.47±11.59	1.88	0.70

Key: KW = Experimental, NKW = Control, FACL = Functional abilities confidence level

Comparison of the post treatment parameters of subject using the independent t-test (Table 4) showed that the group had significantly lower pain intensity than the group (P = 0.04). Lumbar spine flexibility was also higher in the experimental group (P = 0.01). Result showed that there was no significant difference in the FACL between the experimental and control groups. The relationship between post-treatment parameters of pain intensity and lumbar spine flexibility were studied using Spearman correlation coefficient (Rho) (Table 5). The analysis showed that there was an inverse relationship between FACL and pain intensity in the two groups. This relationship was stronger in the experimental group than the control group (r = -0.67 and r = -0.49 respectively). A linear but weak relationship was established between FACL and lumbar spine flexibility (r=0.09 and r=0.13) for the experimental and control groups respectively.

DISCUSSION

This study was a 6-week treatment programme of chronic mechanical low back pain subjects. Forty-five volunteers with chronic mechanical low back pain were involved in the study but only 30 subjects completed the week treatment programme. The rate of subjects drop-out was therefore 33.33% and most subjects dropped out between the 3rd and 4th week. This observation might be because most subjects had appreciable pain relief by the 3rd or 4th week.

In this study, the experimental and control group subjects were matched in pain intensity, lumbar spine

Table 3. Comparision of pre- and post-treatment parameters of subjects

	KW Group (n=15)				NKW Group (n=15)			
	Pre-Test $\bar{X}$±S.D	Post-Test $\bar{X}$±S.D	t-value	p-value	Pre-Test $\bar{X}$±S.D	Post-Test $\bar{X}$±S.D	t-value	p-value
Pain Intensity	7.93±2.76	0.67±0.90	11.18	0.00*	7.33±2.13	0.93±0.88	12.91	0.00*
Lumbar Spine Flexibility (cm)	6.87±1.53	7.27±1.12	-1.54	0.15	6.19±1.62	6.30±1.25	-0.58	0.57
FACL	36.00±6.80	42.67±1.76	-4.75	0.00*	29.47±11.59	41.80±1.42	-4.40	0.00*

Key: KW = Experimental, NKW = Control, t-value = Independent t-test, FACL = Functional abilities confidence level
*Significant at $P < 0.05$

flexibility and functional ability confidence level (FACL) at the point of recruitment into the study (baseline values). Hence the results obtained after the 6-week treatment could only have been due to the differential effects of the intervention procedures. There was a significant reduction in pain intensity in each of the

Table 4. Comparision of post 6-weeks treatment parameters of subjects

	KW Group (n=15) $\bar{X}$±S.D	NKW Group (n=15) $\bar{X}$±S.D	t-value	p-value
Pain intensity (0-10 scale)	0.67±0.09	0.93±0.88	2.22	0.04*
Lumbar spine flexibility (cm)	7.20±1.12	6.30±1.25	2.88	0.01*
FACL (0-100 scale)	42.67±1.76	41.80±1.42	1.48	0.15

Key: KW = Experimental, NKW = Control, FACL = Functional abilities confidence level, *Significant at $p<0.05$

experimental and control group subjects after the 6-week treatment duration. This observation suggests that a combination of heat therapy, massage and back care education with or without Kraus-Weber (strengthening and mobilization) exercises is effective in the management of pain in low back pain. Heat therapy and massage are known to affect pain relief through several general and local physiological effects. These include increase in body temperature, increase in blood flow and consequently muscle relaxation and relief of pain[5].

In a similar study involving the use of abdominal exercise and back care education in the management of low back pain, it was reported that both protocols of abdominal strengthening exercise and back care education used separately were equally effective in managing low back pain[16]. There was a significant increase in FACl in both the experimental and control groups. This may be linked to a significant reduction in pain intensity observed in both groups. According to Williams and Myers[14], low back pain subjects improved on functional abilities confidence scale (FACS) as their pain level decreased. There was no significant improvement in the lumbar spine flexibility of subjects in the experimental and control groups. This lack of significant difference in lumbar spine flexibility might have been because prior to intervention, a large percentage (86.67%) of the subjects involved in this study had full range lumbar spine flexibility as evident by their ability to touch their toes with their fingertips.

At the end of 6-week treatment, the pain of subjects in the experimental group was more significantly relieved

Table 5. Relationship between post-treatment parameters of FACL and each of pain intensity and lumbar spine flexibility

	FACL	
	KW Group r - value	NKW Group r - value
Pain intensity	-0.67	-0.49
Spinal flexibility	0.09	0.13

Key: FACL = Functional abilities confidence level, KW = Experimental, NKW = Control, r = Spearman correlation coefficient (Rho)

compared with subjects in the control group. This result suggests that while a combination of heat therapy, massage and back care education only (as applicable to the non-Kraus-Weber group), was effective in relieving low back pain, addition of Kraus-Weber exercise to these treatment modalities in the experimental group ensured better treatment outcome. This basis for this trend lies in the fact that Kraus-Weber exercise is a combination of strength and flexibility exercise. Exercise training generally increases muscles strength result by causing an increase in cross sectional area of the muscles, which is a determinant of the capacity of a muscle to generate force. This stress of force generated improves the strength of the back muscles and thus give support to the lumbar spine. This in turn resists the forces, which act on the lumbar spine. It also avoids excessive loading which exacerbate an existing structural weakness[17]. According to Hanson and Merritt[18], trunk-strengthening exercises reduce stresses on pain sensitive structures by improving the mechanical efficiency of the spinal-muscular support. Increased spinal motion has also been shown to correlate with improvement of lower back disorders[18], however, the mean value of post-treatment functional abilities confidence level (FAQ) in the experimental group was slightly higher. This slight difference may be accounted for by better pain relief experienced in the experimental group. According to Williams and Myers[14], low back pain subjects performed better on functional abilities confidence scale as their pain level decreased.

A positive significant relationship was observed between pain and FACL in both groups studied. This may be because as pain decreases, an individual tends to regain lost confidence in carrying out activities of daily living. Low back pain patients performed better on FACS as their pain level decreased. There was however a stronger relationship observed in the experimental group subjects. This observation might be an indication of better treatment outcome. According to Mc Auley et al[20] self-confidence is a better predictor of treatment outcome than actual physical abilities. There was a weak relationship between lumbar spine flexibility and FACL. This might be because there may be really no direct association and lumbar spine flexibility.

Based on the findings of this study, it was concluded that a combination of heat therapy, massage and back care education with the inclusion of Kraus-Weber exercises produced significant improvement in the symptoms of chronic mechanical low back pain.

REFERENCES

1. Heger S: Psychomatic aspects of failed back syndromes; why low back pain becomes a chronic disorder. Nevernatzt. **1999**;70:225-232.
2. Moffat KJ, Richardson C, Sheldon T: Back pain: Its management and cost to society. Discussion paper 129. New York University Centre for Health Economics, U.S.A. **1995**.
3. Battie MC, Cherkin DL, Dunn R, Ciol MA, Wheeler KJ: Managing low back pain attitude and treatment preference of physical therapists. Physical Therapy **1994**;74:219-226.
4. Sihvonen T, Huttumen M, Makkonen M, Airkisnen O: Functional changes in back muscle activity correlate with pain intensity and prediction of low back pain. Archives of Physical Medicine and Rehabilitation. **1998**;79:1210-12.
5. McArdle WD, Katch FI, Katch VL: Training muscles to become stronger, Exercise Physiology, Energy, Nutrition and Human Performance. 4th ed., U.S.A. Lippincot Williams and Wilkins (A Waverly Company), **1996**;429- 430.
6. Suzuki N, Endo SA: A quantitative study of muscle strength and fatiguability in the low back pain syndrome. Spine. **1983**;8:69-74.
7. Jette AM, Smith K, Haley DM, Davis KD: Physical therapy episodes of care for patients with low back pain. Physical Therapy **1994**;74:101-115.
8. McGill SM: Low back exercises: Evidence for improving exercise regimes. Physical Therapy **1998**;78:755.
9. Safrit MJ, Wood JM: Introduction to Measurement in Physical Education and Exercise Science. Missouri Mosby, 3rd ed, **1995**, pp 449-450, 642-643.
10. Sanya AO, Olajitan AA: Comparison of abdominal muscle strength in parous and nil-parous subjects. African Journal of Medicine and Medical Sciences **1999**;28:49-53.
11. Hamzat TK, Sanya AO: Kraus Weber exercise test for screening low back pain vulnerability. African Journal of Biomedical Research. **1999**;2:129-133.
12. Babalola JF, Awolola OE, Hamzat TK: Reliability of Kraus-Weber exercises as an evaluation tool in low back pain susceptibility among apparently healthy University students. Journal of Physical Education and Recreation. **2002**;1:814-820.
13. Price DD, Mc Grath R, Raffi A, Buckingham B: The validation of the visual analogue scales as ratio scales measures for chronic and experimental pain. Pain. **1983**;17:45-56.
14. Williams RM, Myers AM: Functional Abilities Confidence Scale: A clinical measure for injured workers with acute Low back pain (FACS). Physical Therapy.**1998**;78:624-634.
15. Mathews DK: Measurement in Physical Education, Philadelphia.W.B. Saunders Company **1978**.

16. Helewa A, Goldsmith CH, Lee P, Smythe HA, Forwell L: Does Strengthening abdominal muscles prevent low pack pain? - a randomized controlled trial. Journal of Rheumatology. **1999**;26:1808 -15.
17. Mallac C, Larson U, Watson A, Burden A, Brandom R, Anderson O, Haddad FS, Macdonald R: Low back pain. Sports Injury Bulletin, London. Electric Word Publishing Pic. **2001**.
18. Hanson TJ, Merrit JL: Rehabilitation of patients with low back pain. Rehabilitation Medicine Principles and practice. Philadelphia J.B Lippincot **1988**;726-735.
19. Mellin G: Correlation of spinal mobility with degree of chronic low back pain after correlation for age anthropometric factor. Spine **1987**;12:464-468.
20. McAuley E, Lox C, Duncan TE: Long-term maintenance of exercise, self-efficacy, and physiological change in older adults. Journal of Gerontology. **1993**;48:218-224.