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FFECTS OF PILATES ON LOW BACK PAIN AND URINE CATECHOLAMINE

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Abstract
Purpose. The popularity of the Pilates method created by Joseph H. Pilates in the early 1920s has increased worldwide in the last decade, confirming the fact that Pilates is much more than a fitness fad. According to a survey conducted by American Sports Data Inc, more than 10.5 million Americans participated in a Pilate's class in 2004. The aim of this study was to determine effectiveness of Pilate's protocol in decreasing of low back pain and urine catecholamine levels.
Methods. Twenty athletes. Recruited for the study were between the ages of 22 and 25 years old, with a mean age of 24 years. Divided into two groups, experimental group consisted of (10) athletes. Control group consisted of (10) athletes. All two groups had chronic low back pain. Pilate's exercises were eight-week period for experimental group.4 days weekly.
Results. The experimental group showed improvement increase in lumbar spine flexion and extension but not significant between the pre and Post measurement. Significant differences between two groups in the urine catecholamine levels.
Conclusions. Urine catecholamine can be used an indicator to sports injury.
Key words: Pilates, low back pain, urine catecholamine.

Introduction:
Low back pain (LBP) is a major cause of disability in many societies (G. Waddell, 1998) and is the most common diagnosis for patients treated in outpatient physiotherapy settings (A. Jette & K. Davis, 1991). Approximately 10-20% of sufferers of LBP develop chronic LBP (CLBP), which is described as pain and disability persisting for more than three months (C. Maher, et al.1999). The origins and predisposing factors of chronic low back pain are unclear, but it appears that muscular dysfunctions have an important role to play in the aetiology of low back disorders.(W. Kirkaldy-Willis & H. Farfan, 1982).
Treatment for low back pain varies from over-the-counter anti-inflammatory to surgery. Because of the invasive nature of surgery, side effects, and low success rate many patients and their healthcare providers chose to turn to more conservative options if they are able. Exercise is an intervention that has been shown to play a major role in the successful management of CLBP (C. Maher, 2004, M. van Tulder, et al. 1997). One exercise approach, Pilates is one of those options and has been shown to be effective in the treatment of low back pain.
There is little doubt that back pain can start as a physical problem in the back. It has been argued that non-specific LBP arises from dysfunction or physiologic impairment (G. Waddell, 2004).
Dysfunction depends on the level of demand or stress, and the capacity of the musculoskeletal system to respond to physiological and biomechanical demands or stresses. Any position that increases the physical stress to the joints may be a called "faulty posture" (F. Kendall, 1983).
Mechanical factors are frequently reported to be associated with the initial onset and recurrence of LBP (P. O'Sullivan, 2005). There are multiple risk factors associated with the occurrence of LBP, some of these factors are; repetitive motion; curvature and torsion of the spine; pushing and pulling activities; stumbles; falls; and static or sitting work posture (J. Cholewicki & S.M. McGill, 1996). However the presence of these does not necessarily lead to the occurrence of back pain, and absence of these factors does not necessarily prevent LBP from occurring.
Exercise is an intervention that has been shown to play a major role in the successful management of CLBP (C. Maher 2004, M. van Tulder, et al 1997). One exercise approach, referred to as Pilates, has in recent years become a popular trend in rehabilitation, with over five million registered practitioners in the United States (Chang 2000).
Pilates is growing rapidly. Joseph Pilates developed it in the early 1900's as a rehabilitation technique for bed-ridden patients. Pilate's exercises can be performed on the floor or with the use of specialized Pilate's equipment. Regular Pilate's workouts improve flexibility and core strength. The increase in core strength achieved through Pilates is one of the main reasons for its success with people with low back pain.
Physical exercise can impose a significant stress on the organism, and the extent of the response depends on several factors such as exercise intensity and duration and training status of the individual (D.A. Péronnet, et al. 1981: R.S. Mazzeo, 1991).
Catecholamines are both neurotransmitters and hormones, and play a dominant role in helping the individual respond to the stress of exercise.
Currently there are several different styles of Pilates, and these can be conveniently divided into two main schools: the repertory approach (sometimes labelled 'traditional' or 'classical Pilates'), and 'modern Pilates' (P. Latey, 2001). The repertory approach follows closely the 34 traditional mat exercises described in Return to Life (J. H. Pilates, & W. J. Miller, 1945). The exercises are vigorous with a fast, dynamic rhythm and are difficult to execute correctly, particularly for people with musculoskeletal impairments. To do these

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exercises requires substantial muscular strength and a "good to high level of flexibility" (P. Latey, 2002). The repertoire is designed to challenge and strengthen the abdominal or trunk muscles referred to as the "powerhouse", by maintaining a "flat back" or 'imprinted spine', where the lumbar spinal curve is pressed to the floor, whilst locking or holding of the upper abdominals, hip flexor origins, and glutei muscles (P. Latey, 2002). This approach has been criticised (P. Latey, 2002) in light of research that has identified the muscle function and connections of the lower abdominal muscles and the pelvic floor.

The main catecholamines are epinephrine (adrenaline), nor epinephrine (noradrenalin), and dopamine. They break down into vanillylmandelic acid (VMA) and metanephrine, which are passed in the urine. (KD. Coutts, et al.1983)

In recent years, some studies have been conducted to evaluate the relationship between urine catecholamine responses and severity of sports injury in athletes. (Hamza, 2004)

According to (Bloomfield, et al.1994) It is unknown whether the catecholamine (CAT) response to acute exercise and prolonged training in humans with spinal cord injury (SCI) is similar to that of neurologically intact man.

Unfortunately, the increasing numbers of Pilates Method's clients and practitioners have not been accompanied by a concomitant development of research. For example, only 13 results. of those, only two studies utilized interventions, one quasi-experimental study whose outcome measure was leaping ability and one experimental study in which the intervention was resistance exercise (Pilates based but not precisely Pilates exercises) and primary outcomes measures were adherence and participation. In a review investigating physical treatment for chronic low back pain, C. Maher (2004) considered Pilate's therapy an unevaluated treatment in which efficacy is unknown. The authors are also not aware of any descriptive study focusing on Pilates clients' characteristics.

Spinal stability exercise has been shown to improve pain and disability in CLBP. (Ferreira, et al.2006)

The research in trunk control has been an important contribution to the understanding of neuromuscular reorganisation in back pain and injury. As long as four decades ago it was shown that motor strategies change in injury and pain (M.A., Freeman, et al. 1965).

Low back pain and its associated disability poses an economic burden to society, mainly in terms of the large number of work days lost (indirect costs) and to a lesser extent by direct treatment costs (M. Krismer et al., 2007; S. Dagenais, et al. 2008). In New Zealand it is estimated that 20 – 25% of all workplace injuries are related to LBP (H. Firth, et al. 2002). With the total cost to New Zealand's society (including indirect costs) estimated to be NZD $500 million annually (D. McBride, et al. 2004). In Australia, the total cost of LBP has recently been estimated to be more than AUD$9 billion per year, with a national prevalence of 65% annually (S. Dagenais et al., 2008).

Pilate's exercises have many similarities to stability exercises but lack strong research evidence of effectiveness. The knowledge of Pilates and degree of training under taken for its use in the management of chronic low back pain (CLBP) amongst Irish physiotherapists is currently unclear. Hence, the aim of this study was to determine the Effect of Pilate's exercises in decreasing of low back pain and urine catecholamine levels.

Methods.

Twenty patient athletes recruited for the study were between the ages of 22 and 25 years old, with a mean age of 24 years. Divided into two groups, experimental group consisted of (10) patient athletes. Control group consisted of (10) patient athletes. All two groups had chronic low back pain. Pilate's exercises were eight-week period for experimental group.4 days weekly. There were no drop-outs as all 10 patient athletes in each group completed the study. In Table (1): the mean and standard deviation values of height, weight, age and duration of pain and baseline scores of the Roland Morris Disability Questionnaire for each group are presented.

Selection of the sample:

The subjects volunteered to be part of the study. Those who complied with the selection criteria were randomly allocated to the Pilates or control group using a process of concealed random allocation.

Inclusion criteria:

- Recurrent low back pain for longer than three months with no sign of abating.
- With or without pain into the lower limbs.
- The subjects fell into the age group of 20 to 65 years.

Exclusion criteria:

Subjects were excluded for the following reasons:

- Previous spinal surgery
- Diagnosed inflammatory joint disease
- Red flag signs and symptoms. These patients were sent for further investigations.
- Motor or sensory neurological signs
- No informed consent
- Inability to adhere to the exercise programme. These were subjects that were excluded as they anticipated that attendance would be problematic or difficult.
- Previous or current participation in a Pilates or back class program.

Procedures:

One examiner who had previously been instructed made the measurements about how to carry out the tests. The examiner, using a simple goniometer, such that all the volunteers performed each movement, obtained the flexion and extension measurements on the lumbar spine consecutively twice. To avoid the variations, consecutive measurements were made during the same period of the day by same examiner .

The evaluations on the flexion and extension range of motion of the lumbar spine were made using a simple goniometer after instructing the volunteer regarding positioning and the correct way of doing the test. The individuals began the test in an upright standing position, with the knees completely extended and arms in front of the body. Then, upon a verbal command from the examiner, they made slow and gradual movements for flexion and extension as far as the

maximum amplitude, at which point the goniometer measurement was made. To evaluate lumbar flexion, the arms had to be flexed at 90 degrees, and to evaluate lumbar extension, the arms had to be kept fixed behind the neck. For these measurements, the iliac crest was taken as the fixed reference point, while the mobile point used was the axillaries line collateral to the iliac crest interiorly, such that the fixed arm of the goniometer remained central in the lateral region of the trunk. (Carla, et al. 2010)

Sorensen's Test

This test measures the time a subject can keep the unsupported trunk (from the upper border of the iliac crest) horizontal while lying prone on an examination table until they can no longer control the posture, or can no longer tolerate the procedure or until symptoms of fatigue are reached. (Moreau et al. 2001) Of the assessment strategies available, isometric endurance testing seems to be cost-effective and requires little or no equipment at all.

The procedure was carried out as follows:

- The patients had to lie prone on a plinth with the trunk (from the upper border of the iliac crest) unsupported, with the hands either behind the head or placed across the chest
- The researcher held down the patients' legs with the researcher's body weight This was done to reduce time in the patient set-up when performing the test
- The patients were required to extend the trunk until the back was in line with the rest of the body
- This position was to be maintained until the posture could no longer be controlled, or no more tolerance for the procedure or symptoms of fatigue are reached

The examiner recorded the time held by each patient (in seconds) for the test. A Swatch Irony watch was used to record the times for all 20 patient athletes to maintain continuity .

Pilates Training protocol.

A Pilate's mat was used during training sessions for subject comfort. The exercises used in the Pilates core training program included: standing footwork, the hundred, articulating bridge, the plank, reverse plank, rolling like a ball, and side plank. These exercises were developed in the 1920s by Joseph Pilates.

Standing Footwork. This exercise was used as a warm-up. It focused on lower body strengthening, flexibility and core stability. It strengthened the muscles of the legs and pelvis, increased hip flexibility, strengthened the core, and improves balance.

Hundred. This exercise is used as a warm-up. It focuses on core strengthening and stability. The hundred increased circulation and prepared the body for additional exercises. It strengthened abdominal muscles and increased spinal flexibility.

Articulating Bridge. The articulating bridge was used as a warm-up exercise. It focused on core strengthening and lumbar flexibility. It increased spinal flexibility and strengthened the abdominal muscles, lower back muscles, gluteals, and hamstrings.

Plank. This exercise focused on the upper body, core strength, core stability, and lower body flexibility. It strengthened the shoulders, upper back, and arms, increase stability and strength to the core, as well as increasing flexibility at the hips.

Reverse Plank. This exercise focused on core and lower body strengthening, upper body flexibility and strengthening. It strengthened the abdominals, back, hip extensors, and upper extremity.

Rolling Like a Ball. This exercise focused on core strength, core stability and spinal flexibility. It strengthened the abdominal muscles, improved balance, and increased spinal flexibility.

Side Plank. This exercise focused on core and upper body strength and stability. It strengthened the core, arm, and superior back muscles, the exercise also increased strength specifically in the quadratus lumborum, gluteus medius, rotator cuff, as well as increasing stability to the shoulder.

Statistical analysis

All statistical analyses were calculated by the SPSS statistical package. The results are reported as means and standard deviations (SD). Differences between two groups were reported as mean difference ±95% confidence intervals (mean-diff ± 95% CI).Student's t-test for independent samples was used to determine the differences in fitness parameters between the two groups. The $p<0.05$ was considered as statistically significant.

Results

Table 1.Mean ±SD values of age, height, weight and duration of pain and baseline scores of the Roland Morris Disability Questionnaire (RMDQ) for each group

	Groups	Age (years)	Height (cm)	Weight (kg)	Duration (months)	RMDQ (deg)
Mean ±SD	**Pilates**	**23.45 ± 2.4**	**171.05 ± 5.5**	**70.76 ± 8.4**	**15.78 ± 8.4**	**7.4 ±1.2**
Mean ±SD	**Control**	**26.22 ± 3.6**	**168.32 ± 7.3**	**68.11 ± 11.2**	**17.65 ± 10.5**	**6.5 ± 0.9**
p value		**0.232**	**0.547**	**0.332**	**0.475**	**0.651**

The p value for all variables between the two groups not differed significantly in this regard.

Table 2.Mean ±SD and the significant for Goniometer flexion, Goniometer extension, Sorensen's Test and (RMDQ) between the pre-post measurements for experimental group.

Variables	Experimental group			Sig.
	pre	post	change%	
Goniometer flexion	109.7 ± 9.13	117.25 ± 8.58		Sig.
Goniometer extension	37.65 ± 3.54	44.23 ± 6.32		Sig.

Sorensen's Test	41.76 ± 7.98	52,27 ± 9.64		Sig.
RMDQ	7.41 ± 1.2	4.65 ± 2.8		Sig.

Is clear from Table (2) the post tests for experimental group had significantly higher than the pre tests in all variables and Significant improvements were observed in RMDQ

Table 3.Mean ±SD and the significant for Goniometer flexion, Goniometer extension, Sorensen's Test and (RMDQ) between the pre-post measurements for control group.

Variables	Control group			Sig.
	pre	post	change%	
Goniometer flexion	110.21 ± 10.15	112.38 ± 7.87		No Sig.
Goniometer extension	38.64 ± 6.68	40.11 ± 5.45		No Sig.
Sorensen's Test	40.11 ± 4.91	42.59 ± 4.38		No Sig.
RMDQ	6.5 ± 0.9	6.35 ± 1.3		No Sig.

Is clear from Table (3) no significant differences between the post tests and pre tests for control group in all variables .

Table 3.Mean ±SD and the significant for Goniometer flexion, Goniometer extension, Sorensen's Test and (RMDQ) between the post measurements for experimental and control groups.

Variables	Control	Experimental	Sig.
	post	post	
Goniometer flexion	112.38 ± 7.87	117.25 ± 8.58	Sig.
Goniometer extension	40.11 ± 5.45	44.23 ± 6.32	Sig.
Sorensen's Test	42.59 ± 4.38	52,27 ± 9.64	Sig.
RMDQ	6.35 ± 1.3	4.65 ± 2.8	Sig.

Baseline results showed that: The experimental group had significantly higher than the control group in all variables and Significant improvements were observed in RMDQ for the experimental group when comparative with the control group.

strength, with mentions of greater range of motion, muscle symmetry, flexibility, (J. Schroeder et al. 2002) spinal and joint mobility, and proprioception, balance, and coordination. (M. Bryan, S. Hawson. 2003)

In a previous systematic review, (La Touche, et al. 2008) highlighted the importance of distinguishing Pilates-based exercises from the classic Pilates Method. The Pilates Method is an exercise form that has been popular for decades among choreographers and dance instructors in the field of dance medicine, (B. Anderson and A. Spector 2000)which addresses the causes of dance injuries, promotion of care, prevention, as well as safe postrehabilitation return to dance. (C . Miller, 2006) The neuromuscular demands of the traditional Pilates Method can be high, and, therefore, its application to physiotherapeutic interventions necessitates modifications. (R. Rydeard, et al. 2006) As such, the Pilates-based exercises, as described in the current literature, are adapted and simplified from the traditional Pilates Method, when used for rehabilitation purposes. (V. Gladwell, et al. 2006)The modified Pilates Method was designed with the intent to improve posture and control of movement41via neuromuscular control techniques believed to improve lumbar spine stability through targeting the local stabilizer muscles of the lumbar-pelvic region or "core muscles." (V. Gladwell, et al. 2006)

In addition to Pilates exercises that achieve stability, which are aimed at retraining transversus abdominis

Discussion and conclusion

In this study, it was observed that flexion and extension of trunk presented higher values among individuals who practiced Pilates. This has importance in detecting spinal diseases, and in the response among individuals undergoing treatment.

Pilates Exercise For Low Back Pain is a great exercise for low back pain because it emphasizes movement by core muscles, those closest to the spin. Instead of performing more reps, Pilates focuses on performing fewer, more precise movements that require concentration, control, and proper form. Due to its focus on developing the core muscles as well as postural awareness, Pilates is especially successful at alleviating back pain. By integrating the trunk, pelvis, and shoulder girdle Pilates enables you to develop a strong core. Adding to Pilates exercises are very smooth and controlled movements, so there is little danger of getting injured while exercising.

In recent years, there has been a growing number of reports on the benefits of Pilates-based exercises for low back pain. (M. Bryan, S. Hawson. 2003; A. Dolan et al. 2001; S. Donzelli et al. 2006; V. Gladwell et al. 2006; L. Herrington & R. Davies 2005; C. Lange et al. 2000; J. Schroeder et al. 2002)

Concomitantly, an increasing number of healthcare practitioners are using the Pilates-based approach for rehabilitation. (B. Anderson and A. Spector 2000) Despite the limited number of randomized controlled trials investigating this exercise approach, proponents have claimed improved torso or core

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Stabilization exercises can promote muscular control around the lumbar spine. The knee stretch exercises from the Pilates method have been used in clinical practice to increase lumbar stability. (Bergson et al. 2009)

P. O'Sullivan, et al. (1997) demonstrated effectiveness of a specific stabilisation exercise approach in a CLBP population with a specific diagnosis of spondylolisthesis or spondylolysis.

Within the group who received specific exercise (SEG, specific exercise group) a significant reduction in pain intensity (p=0.0006, effect sizes: CG d=0.21 'trivial'; SEG d=1.78 'very large') and functional disability levels (ODI) (p= 0.0001, effect size CG d= 0.06 'trivial', SEG d=0.88 'large') was observed, with maintenance of this effect at 30-month follow up. No significant changes were seen in a control group receiving usual care. However, despite being often cited this study has not been replicated to date.

Another important result of our study is the significant reduction in the 24-h urine vanillylmandelic acid secretions after the training program; these findings show the quality of the training program design.

Several mechanisms may contribute to decrease of urine vanillylmandelic acid secretions followed 8-week of the Pilates training program. Concerning the adaptations to strength and power training, (RS. Mazzeo, 1991) main factors are referred to in the literature: neural and hypertrophic. JH. Green, 1990)

According to the results :

Pilates-based exercises are superior to minimal intervention for reduction of pain in individuals with nonspecific low back pain. However, Pilates- based exercises are more effective to reduce pain. In addition, Pilates exercises are more effective than minimal intervention or other exercise interventions to reduce disability related to chronic low back pain. To have a more accurate representation of the extent of pain or disability reduction in such musculoskeletal pain condition, studies with better methodological qualities are needed.

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