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EVIDENCE-BASED PHYSIOTHERAPY WITH **DEEP WATER RUNNIG** ON NON-SPECIFIC LOW BACK PAIN *VERSUS* EVIDENCE-BASED PHYSIOTHERAPY ONLY: A RANDOMIZED CONTROLLED TRIAL

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Background (1/2)

- Systematic reviews have concluded that of the Manual Therapy (MT) in start, exercise therapy (EX), behavioural therapy and education (ED) is a best options in treatment on Chronic non-specific low back pain (CLPB) (COST B13 Guidelines EBM-Europe, 2006)
- Evidence-Based Physiotherapy (EBP) = **MT** (normalisation)+**EX**+**ED**
- Aerobic exercise has recently been included in the treatment of (CLBP). (Chatzitheodorou et al. 2007)
- Aquatic aerobic exercise is particularly popular and is presented in various forms one of which is deep water running (DWR). (Geytenbeek, 2002)
  - The **mechanical** indication for DWR is based on the reduced compression of the lumbar spine, (Dowzer et al. 1998)
  - The **physiological** indication is that pain is reduced due to the activation of the hypothalamus - pituitary - adrenal (HPA) axis, which gradually increases the plasma cortisol concentration levels during exercise above 60% of maximum oxygen consumption (Branderberger, 1985).
  - DWR is a **feasible** aerobic exercise with persons with certain grade of disability (Assis, 2006)

Background (2/2)

The effectiveness of DWR as an alternative to other aerobic workouts has also been demonstrated in diverse age groups (Broman et al. 2006).

- Additionally, it is clinically effective in various musculoskeletal disorders, such as hip and knee osteoarthritis (Hinman et al. 2007) and fibromyalgia (Assis et al. 2006).

- Deep water running has been shown to prolong the beneficial effect on functional ability in persons with CLPB following a program of land based physical exercise (Quinn et al. 1994).

*Clinical trial has not been performed on the effectiveness of the **value add** of DWR on CLBP*

Clinical research question

Could a complement of individual high intensity DWR (AT) improve the effect size in a EBP program on pain in CLBP?

The **principal aim** is to analyze the effect on pain, physical and mental health state, disability and functional ability of a multi-model program with: manual interventions at the start, motor learning of control of the local system of trunk stability, the progression of workloads in endurance and strength muscle for CLBP with or without a supplementary program of DWR in AT .

as the choice way of increasing the changes within-group.

Material y Methods

Design : randomized, controlled trial involving two groups was set up.

Participants were diagnosed with non-specific CLBPlasting at least three months.

Therapist and assesors were blinded (pragmatic trial)

Material: exercises room and warm deep pool (28ºC)

Experimental intervention (1/2)

Individual interview

(Qualitative research semi structure) Health Screen Traininig

Individual assessments of physical functions for prescription workloads

Stiffness and Range of Motion (different segmental level) QUALITY MOBILITY

Movements and Motor Control Impairment (directions) QUANTITY MOBILITY (4 level)

Energy Muscular (Endurance and strength) RESISTANCE

(looking for a maximal loads for energy thresholds)

- Gave "Ten points for advice CLBP" (Psycho-social factors risk)
- Ask them active role for compliance and adherence.

Physical Exercise Program (60 min.) with manual therapy, motor learning and education integrated three times per week in 15 weeks.

Physiotherapist carried out supervision and follow up the workloads of exercises and educational behavior intervention based in advice and development of "ten points" while patients practice exercises in group.

Experimental Intervention (2/2)

Value add of Experimental Group

Supplementation of 20 minutes continues with high intensitive aerobic aquatics exercises in DWR with help of wet-belt.

The individual thresholds was calculated in a individual ergometer incremental maximal test (hear rate, blood lacate and Borg Scale) in cycloergometer and DWR too

The prescription of workloads was based in progressive intensitive of 2 , 3 and 4 mmol of lactate every 5 weeks

The supervision of intensitive of training was based in heart rate and Borg scale modified

Normalisation of Chains Muscle and Progresive Motor Learning MOBILITY

(Manual Therapy and Teaching with Mirror feedback) 3*30rep

To reduce articular and miofascial strain and teach the timing of motor control pattern of dailty activities (individual discovery)

Energy
Muscular endurance in swiss ball

- *Isometric Muscular Endurance (*4*30s)

  (Individual arm and weight)



Energy
Stregth with synergy active neutral pelvis zone

- (2*±15 repeticiones r/ 2 min.)

Individual synergy and weight

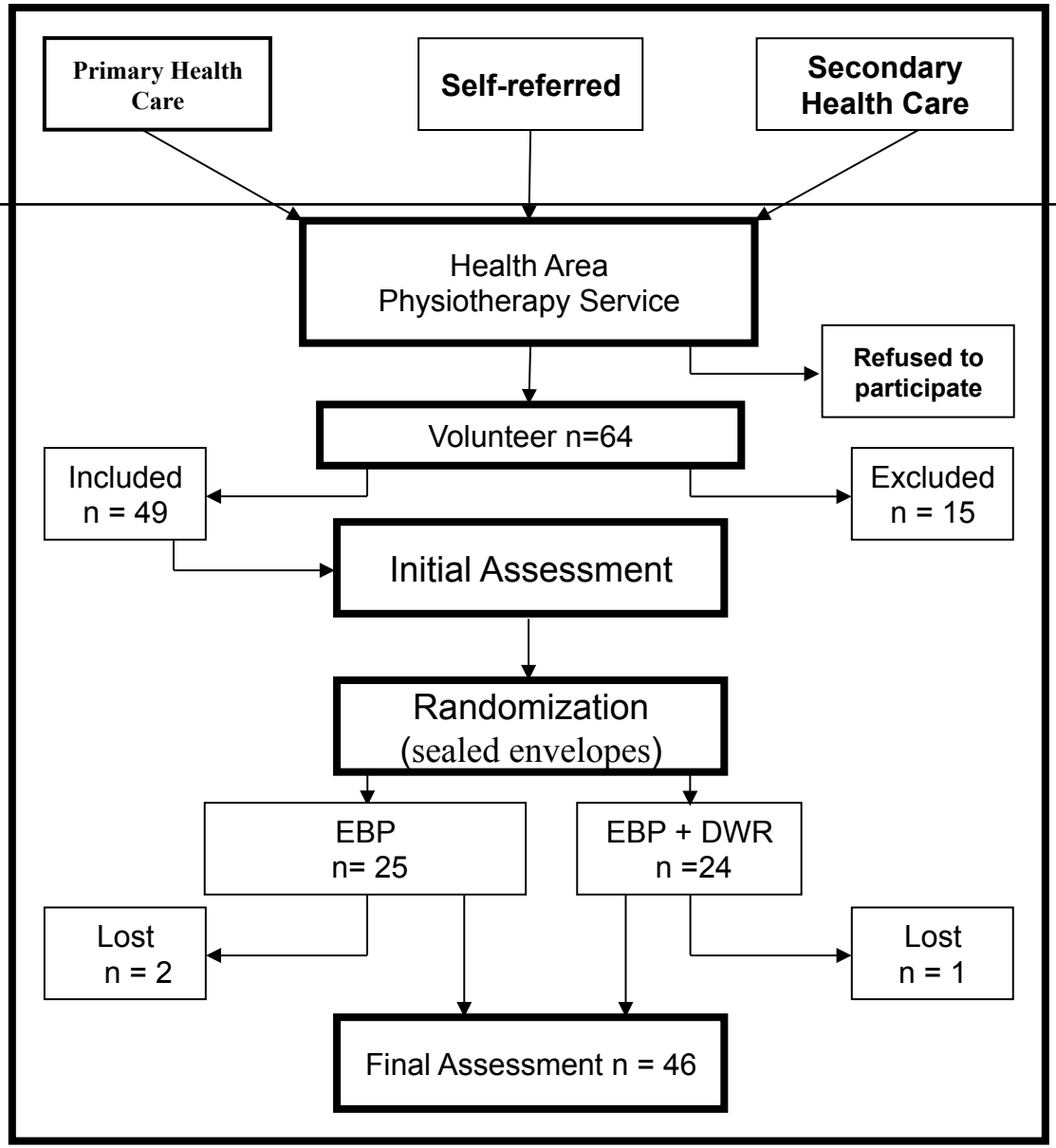
Cardiovascular train
Deep Water Runing

20 min. continuos

Individual directions of pelvis (MCI)

and intensity 2-4 mmol lactate

Spine neutral (no, Flexion And Extension Patterns of CMI)
Simulate running
Line of shoulders
Shoulders flexed with elbows at 90º
Wrist at least 5 cm under the water.
Fists closed
Cyclic movement of legs
Hip flexed 70º
Ankle relaxed
(adverse effect of running)
Trunk inclination <10º (correlation with hip)


Primary Health Care
Self-referred
Secondary Health Care
Health Area Physiotherapy Service
Refused to participate
Volunteer n=64
Included n = 49
Excluded n = 15
Initial Assessment
Randomization (sealed envelopes)
EBP n= 25
EBP + DWR n =24
Lost n = 2
Lost n = 1
Final Assessment n = 46

Variables: Clinical outcomes

- Pain on Visual Analogic scale (**VAS**)
- Disability on Roland-Morris Disability 24 items Questionnare (**RMQ**)
- General Health State on Short Form 12 items survey, **(SF-12).**
  - Physical Health Component PSC-12
  - Mental State Component MSC-12

Variables: Physical Outcomes

- Lumbosacral mobility in flexion in the sagittal plane
  L-ROMflex, degrees

- Strength Test of the Lumbar and hip extensors
  STL test, kg

- Isometric endurance muscle of the lumbar and hip extensors using the Sorensen test
  Sorensen test, seconds

- Level of Motor Control of Local Lumbar Systems
  4 level of impairments, **Motor Control Local Systems (MCLS)**

Comparison between groups at baseline

	EBP + DWR	EBP	*p*
Age, years	39.88±11.21	37.65±13.21	0.563
Body mass index	26.22±3.95	25.21±4.53	0.798
Duration of symptoms, weeks	14.3±9.4	16.9±9.5	0.235
Pain, (100 mm, VAS)	52.53±20.02	57.62±14.19	0.249

Results

Changes	WITHIN-GROUP		BETWEEN-GROUP	
	EBP + DWR	EBP		
	Mean ± SD	Mean ± SD	ARR	95% CI
Pain	-36.06±25.11b***	-34.18±26.05b***	-1.88b*	-28.65 to 11.59
Disability	-3.00±4.85b**	-1.68±1.57b***	-1.32a	-2.42 to 2.28
PHS	10.59±12.89b***	8.93±13.04b**	-1.66a	-0.83 to -11.13
MHS	6.44±14.52a	1.77±12.97a	-4.67a	-3.59 to -10.96
LP-ROMflex,	12,69±24.46b*	13,16±17.29b**	1.38a	-9.22 to 23.04
STL test, kg	12.86±19.10b***	16,86±21.91b**	4.18a	-4.29 to 24.79
Sorensen	37,27 ±15.04b***	21.00±17.43b***	-14.9a	-6.95 to 36.40

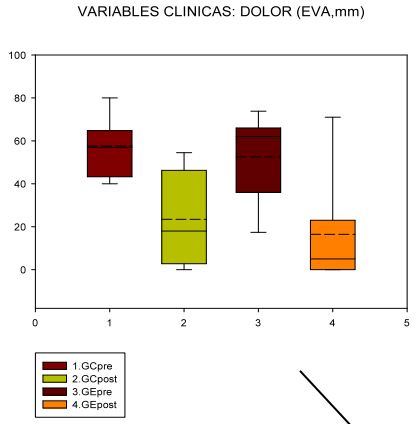
a Non-significant differences with the *t* test for independent samples.
b Significant differences with the *t* test for paired samples.
b *0.05
b ** 0.01
b ***0.001

Results: Pain on VAS (0-100 mm)

WITHIN-GROUP
-34.18±26.05
p < 0,0001 ***

WITHIIN-GROUP
plus DWR
-36.06±25.11
p < 0,0001 ***

BETWEEN
(95%CI-28.65 to 11.59)
p = 0,05*

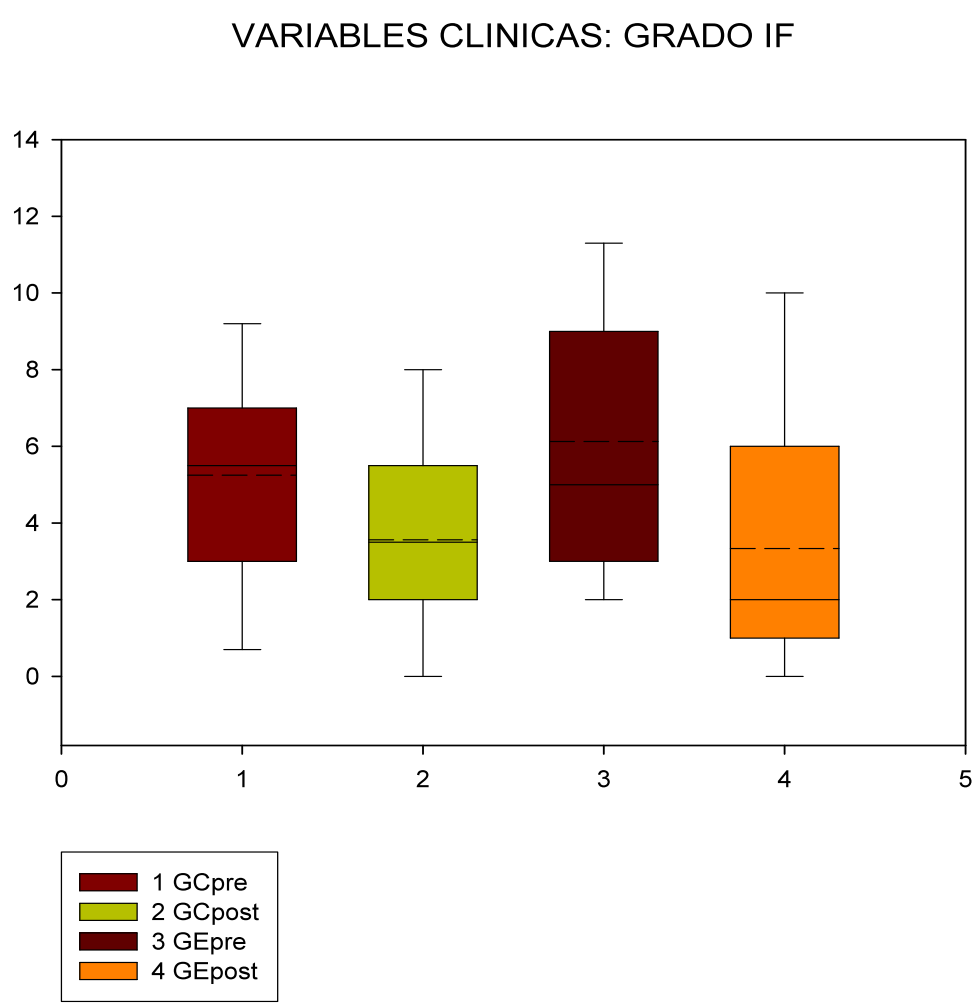


Results: Disability on RMQ (0-24 points)

WITHIN-GROUP
-1.68±1.57b
p = 0,031 **

WITHIN-GROUP
plus DWR
-3.00±4.85b
p < 0,001 ***

BETWEEN
95%CI -2.42 to 2.28
p = 0,952

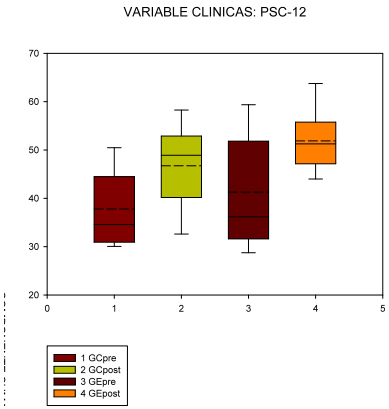


Results: Physical Health on SF-12 (0-100)

WITHIN-GROUP
8.93±13.04b
p = 0,005 **

WITHIN-GROUP
plus DWR
10.59±12.89
p = 0,001 ***

BETWEEN
95%CI-0.83 to -11.13
p = 0,087

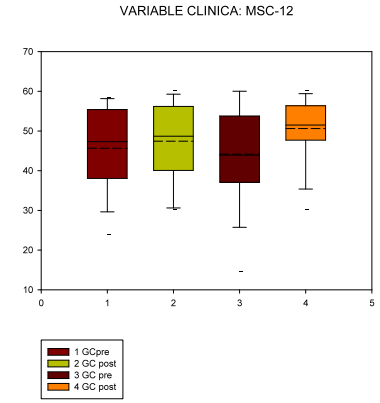


Results: Mental Health on SF-12 (0-100)

WITHIN-GROUP
-1.77±12.97
p = 0,592

WITHIN-GROUP
plus DWR
-6.44±14.52
p = 0,096

BETWEEN
95%CI-3.59 to -10.96
p = 0,397

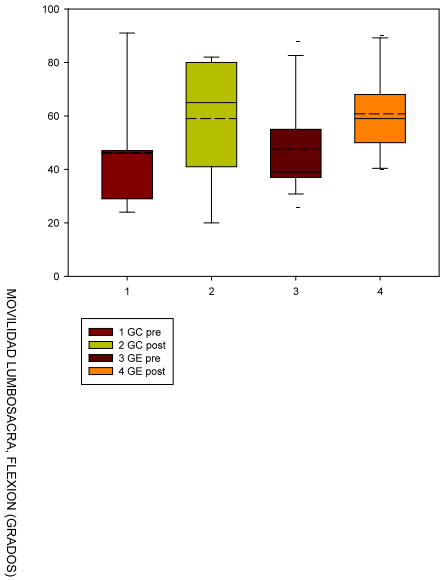


Results: L-ROMflex, degrees

WITHIN-GROUP
13,16±17.29b**
p = 0,010 **

WITHIN-GROUP
plus DWR
12,69±24.46b*
p = 0,043 *

BETWEEN
-1.38a-9.22 to 23.04
p = 0,363

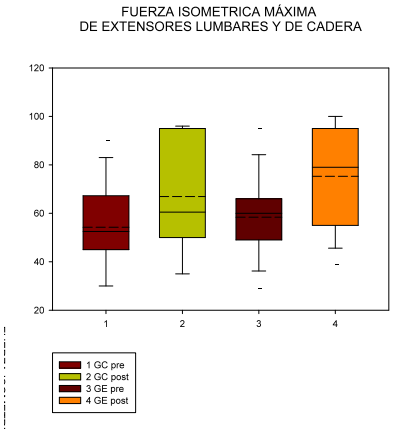


Results: STL test, kg

WITHIN-GROUP
16,86±21.91b**
p = 0,035 *

WITHIN-GROUP
plus DWR
12.86±19.10b***
p = 0,004 **

BETWEEN
95%CI -4.29 to 24.79
p = 0,156

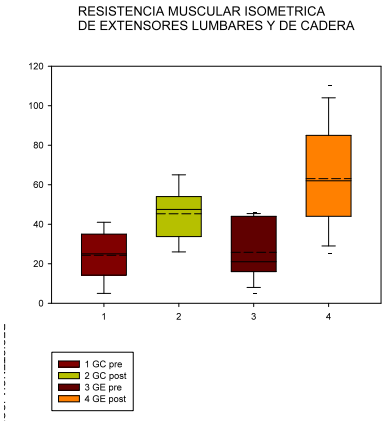


Results: Sorensen test, seconds

WITHIN-GROUP
21.00±17.43b***
p < 0,0001 ***

WITHIN-GROUP
plus DWR
37,27 ±15.04b***
p < 0,0001 ***

BETWEEN
95%IC -6.95 to 36.40
p = 0,161

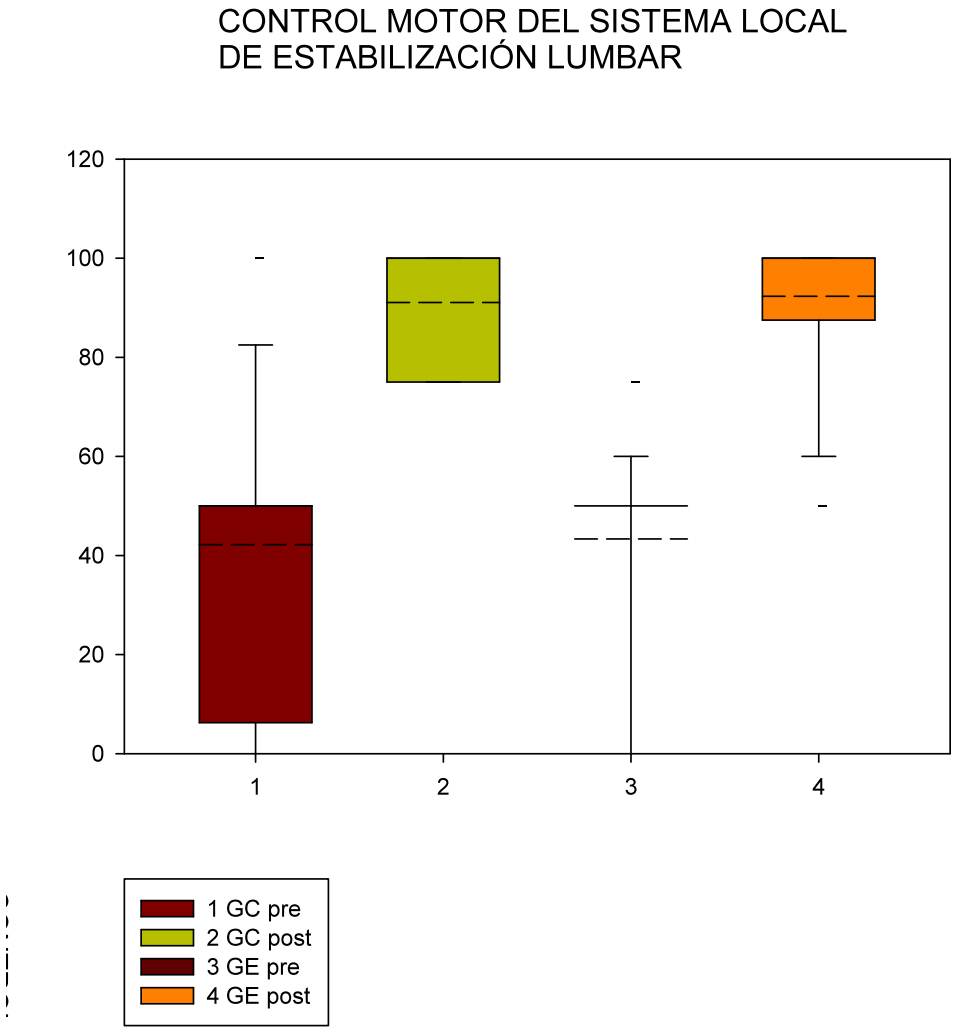


Results:
Motor Control Local Systems (MCLS)

WITHIN-GROUP
$p = 0{,}003$ **

WITHIN-GROUP
plus DWR
$p = 0{,}001$ ***

INTERGRUPO
$\boldsymbol{p} = 0{,}655$



DISCUSSION
Pain and Disability

- A 20% reduction in *pain* score is considered to be a clinically relevant improvement (Van der Roer 2006).
- The changes within-group in EBP+DWR group on pain in VAS of the intervention on CLBP were 36% (ARR) and 70% (relative risk reduction, RRR). Bigger that another multimodel program *(Bendix, 2000; Moseley 2002;)*

- Similar results for the reduction within-group in the *disability* score in 24-RMQ, (Keller 2007; Cairns 2006; Niemisto 2003; Moseley 2002; Frost 1998)
- A 10% reduction in disability score is considered to be a clinically relevant improvement (Van der Roer 2006).
- The changes within-group in EBP+DWR group on disability of the intervention on CLBP was 12% and 48% (RRR)

DISCUSSION

General physical and mental health state

- A 10% reduction in health state score is considered to be a clinically relevant improvement (Van der Roer 2006).

- The changes within-group in EBP+DWR group on physical state of the intervention on CLBP were 10% (ARR) and 18% (RRR). Similar that other studies (Cairns et al 2006)

- Mental state don´t present significant changes

CONCLUSIONS

1 A complement to EBP of DWR at an intensity of the AT produces a significant improvement on pain in VAS in CLBP *over EBP alone*.

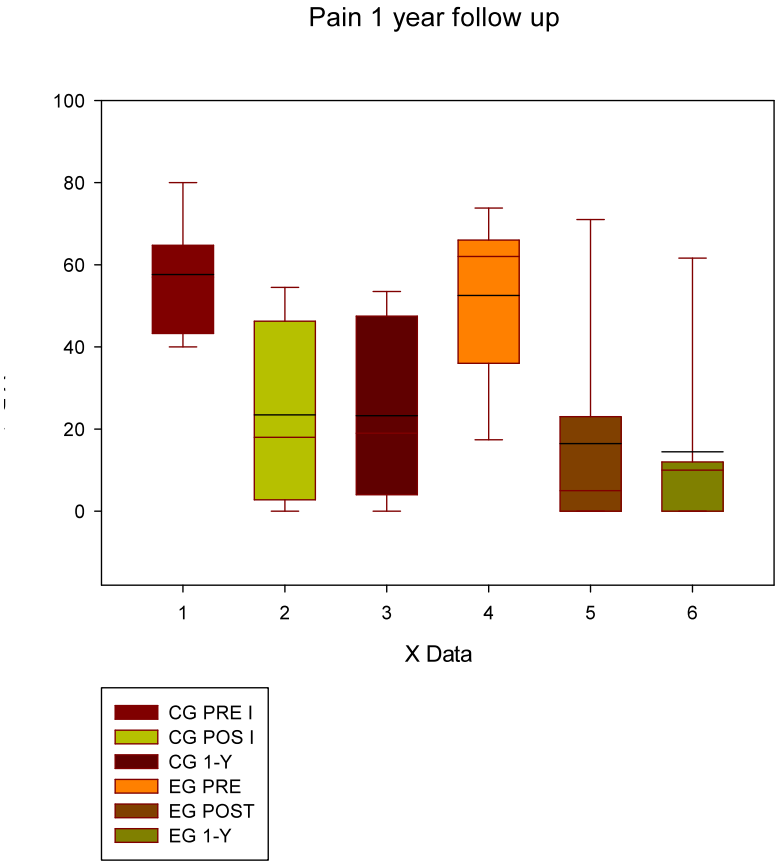
3 A complement to EBP of DWR at an intensity of the AT produces a very significant improvement on pain on VAS, physical health state and strength and endurance muscle in patients *within-group with CLBP*

5 Due to the variability between persons with CLBP, better results are achieved with an individualized plan of strategies according to the initial situation and the evolution of each patient

4 The neuro-endocrine modulation on pain of CLBP may be favored by aerobic exercise at the AT.

Running Studies

- 1 year follow-up
- Semi-RCT with another control group non-randomized intervened with General Medical Practice in Primary Care
- Hormonal response of stress system after high intensity deep water running on CNLP: RCT



ERGOMETER TESTER

The effectiveness of the Deep water running (DWR) as an **alternative** to other aerobic workouts has already been demonstrated in different ages: between young, middle age and older.

Althougt DWR has demonstrated the capacity to extend the feasibility of aerobic workouts, the variability between response in land and in water is unknowed in this population.

ERGOMETER TESTER

Subjects

The study involved 16 CNLBP (8 Caucasian male and 8 female) aged 39.9±11.6 weight 69.7±14.3 kg, height 166 ± 9 cm.

Cyclo CE test

Cycloergometer protocol starting at 45 rpm, The test began with a constant workload of 1´5 W/kg of bodyweight and increases in cycling cadence of 5 rpm every two minutes until physiological or volitional fatigue.

ERGOMETER TESTER

The water ergometer test was undertaken on the same day, as follows: a tubular rubber band stretching from the edge of the pool was tied to the subject's flotation belt.

Supervised water running ergometry was undertaken, with the metronome starting at 60 cycles/min for five minutes, each cycle consisting of one complete cadence cycle (two steps). The speed was then increased by 10 cycles/min every two minutes until physiological or volitional fatigue.

The subjects had previously been instructed to "go all out" during this final minute.

ERGOMETER TESTER

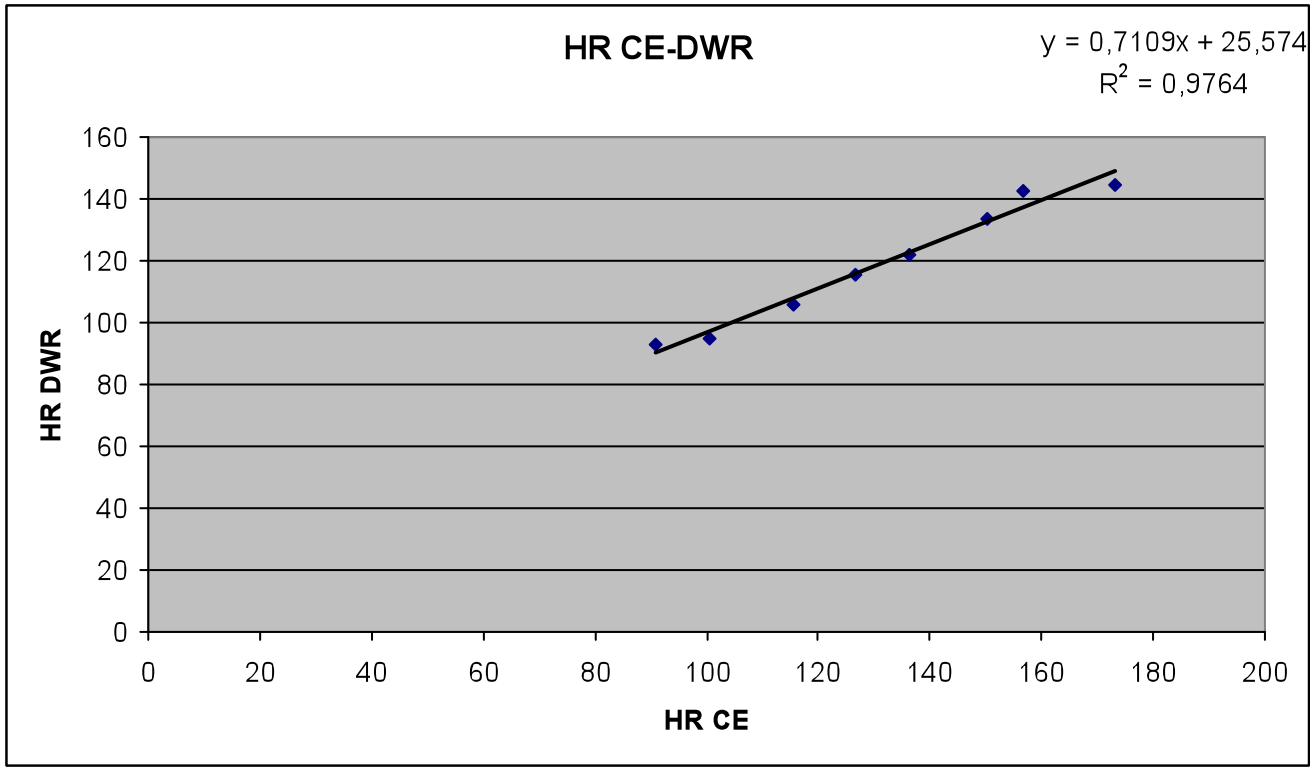
HR was monitored continuously at one-second intervals using a Polar 610i Heart Rate Monitor.

At the same time, ratings of perceived exertion (RPE) were measured. at 2 min intervals using the 10-point Borg Scale Ad (0-10 scale).

The same observers collected all data. At the end of each two-minute stage, without interrupting the incremental process of the test, blood was obtained by puncture of the ear lobe in both tests.

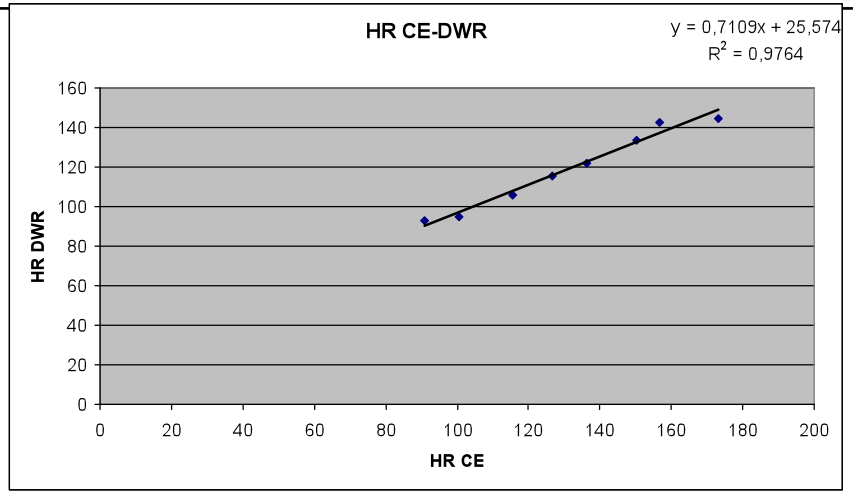
The correct running technique was supervised during the whole test to ensure that the only incremental variable was cadence

ERGOMETER TESTER



ERGOMETER TESTER

- In the water test lower HR were obtained compared with land test in the later steps, maximum heart rate and the recovery period probably due to a different cardiovascular
- However in physiotherapy practice, it could be interesting to estimate a target heart rate for different programmed exercise intensities in DWR from a cycloergometer test and avoid a maximal stress test in water due to its implications about safety and technical execution in a daily practice
- Results bring a correlation equation, that could be useful to make an estimation of target heart rates for exercising in water, obtained from land cycloergometer test.



Ergometer tester

- When prescribing aerobic water exercise for persons with chronic low back pain, the following considerations should be taken into account to estimate the heart rate:
- The direct calculation of HR for aerobic threshold should be made with the specific test in water running, using the procedure described above. This new test could be an alternative for the control of the heart rate in exercise prescription on chronic low back pain.
- The indirect calculation from the laboratory should be made by subtracting

y= **0,7109x+25,574 (r2 = 0,9764)**

Technique DWR

- Spine neutral (no, Flexion And Extension Patterns of CMI)
- Simulate running
- Line of shoulders
- Shoulders flexed with elbows at 90º
- Wrist at least 5 cm under the water.
- Fists closed
- Cyclic movement of legs
- Hip flexed 70º
- Ankle relaxed
- (adverse effect of running)
- Trunk inclination <10º (correlation with hip)

DWR (classical errors)

10 errores:

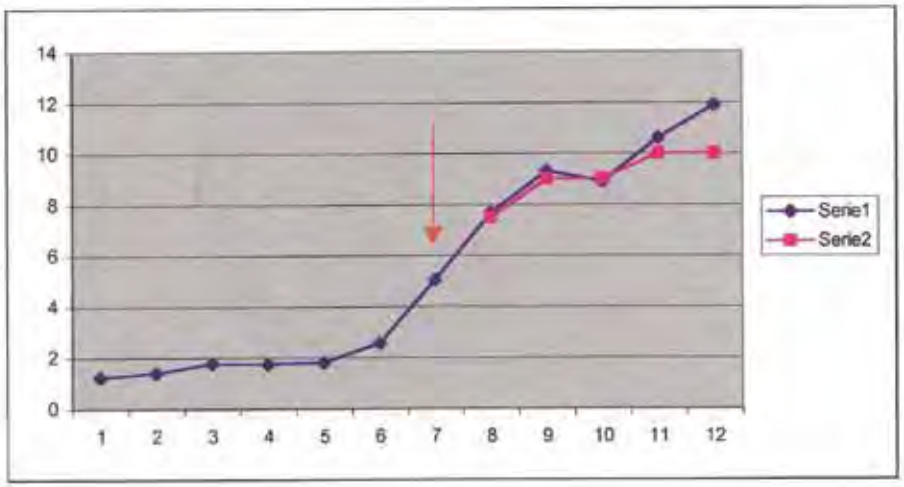
- *Lost "vertical position" (>15º)*
- **Looking for rowing**
- **Adapted workload to the fatigue**
- **Difference of ROM upper-lower limbs**
- **Difference of frecuency upper-lower limbs**
- **Contrarrotatión of girdle**
- **Elevation-forward of scapula**
- **No neutral of pelvis**
- **No relax of ankle**
- **No close the knee in extension**

PRACTICE
ERGOMETER TESTER: EXAMPLE

PISCINA DE TORREMOLINOS VIRGEN DEL CARMEN 16-04-02

DEPORTISTA: HANNES BRINKBORG

BPM	MIN	FC	A. LACT	BORG
60	2	95	1,24	
70	4	97	1,4	
80	6	102	1,77	
90	8	108	1,75	
100	10	110	1,82	
110	12	133	2,58	
120	14	155	5,05	
130	16	151	7,68	7,5
140	18	161	9,32	9
150	20	162	8,9	9
160	22	168	10,6	10
> 170 ALL OUT	23	168	11,9	10

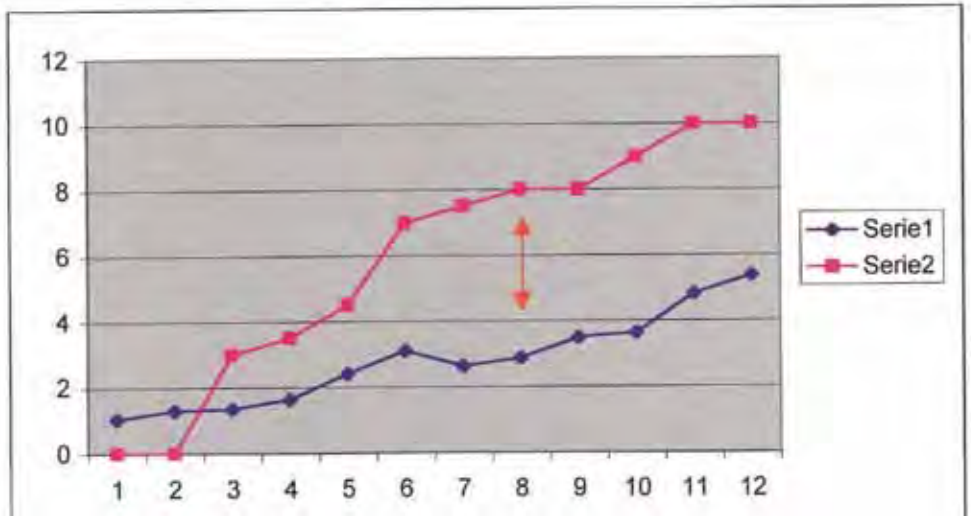


Dr- Antonio I. Cuesta

PRACTICE
ERGOMETER TESTER: EXAMPLE

DEPORTISTA : STAFFAN SALHBERG

BPM	MIN	FC	A. LACT	BORG
60	2	79	1,04	0
70	4	86	1,3	0
80	6	91	1,35	3
90	8	100	1,62	3,5
100	10	112	2,4	4,5
110	12	115	3,1	7
120	14	119	2,62	7,5
130	16	124	2,87	8
140	18	136	3,49	8
150	20	152	3,63	9
160	22	163	4,81	10
> 170 ALL OUT	23	168	5,38	10



Workloads

Continuous work 20 minutes DWR (Cuesta, 2007)

- 1 -5 weeks HR and Borg (1/10) of 2 mmol
- 6-10 weeks HR and Borg of 3 mmol
- 10-15 weeks HR and Borg of 4 mmol

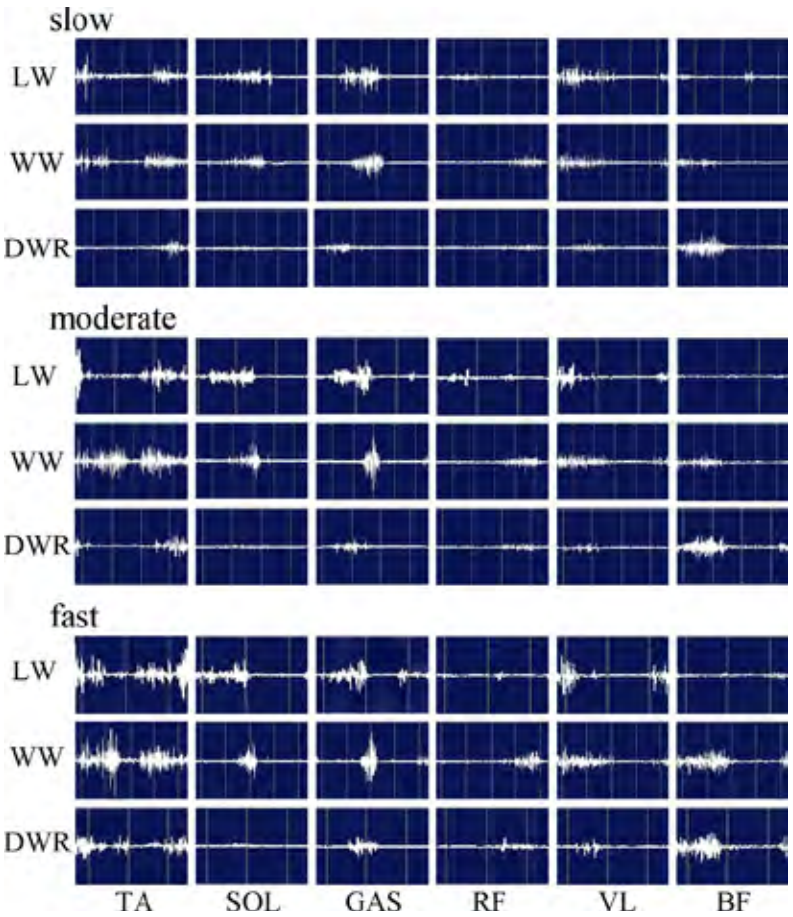
Continuous Vs Interval 32´ (Martins, 2009)

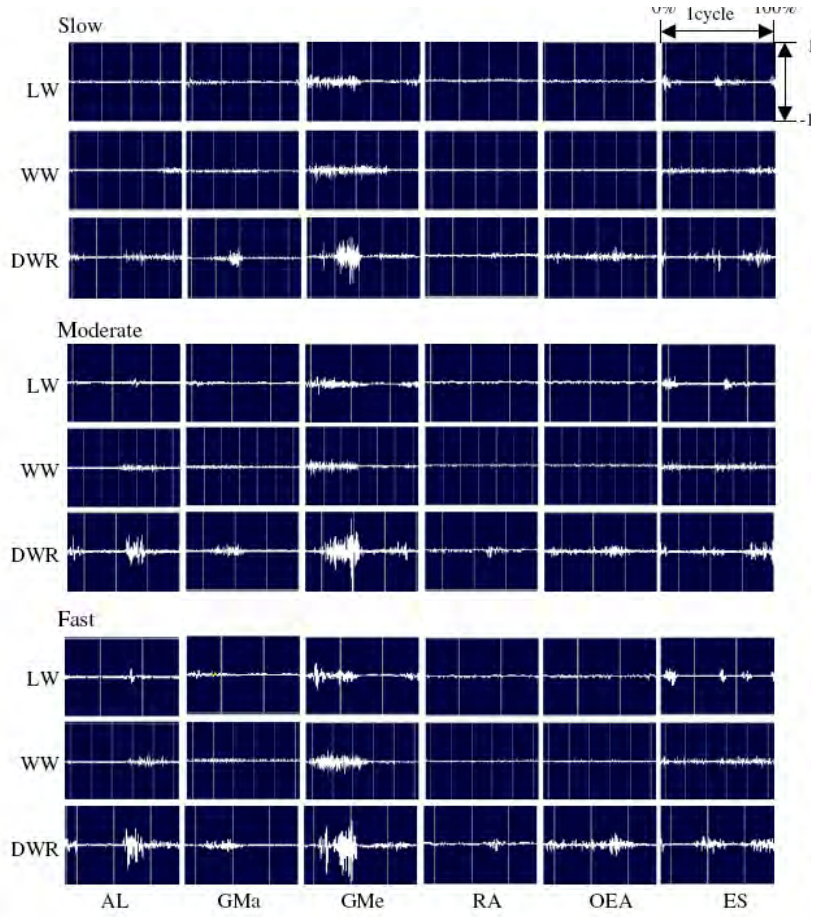
12 RPE Vs 17/13 RPE (1/23) Aerobic exercises

SCALE workloads

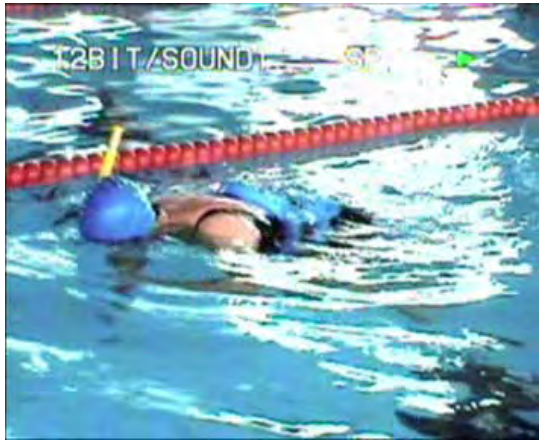
RPE mod scale		BPM Brennan	BPM Wilder
Very Light (2)	1.0 1.5	<55 55-59	48
Light (4)	2.0 2.5	60-64 65-69	66
Somewhat Hard (6)	3.0 3.5	70-74 75-79	
Hard (8)	4.0 4.5	80-84 85-89	
Very Hard (10)	5.0	>90	104

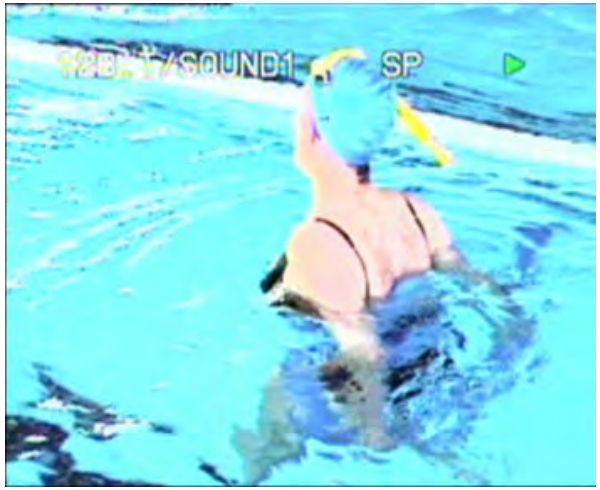
DWR: kinematics and EMG (Sato et al , 2008a; Sato et al 2008b)

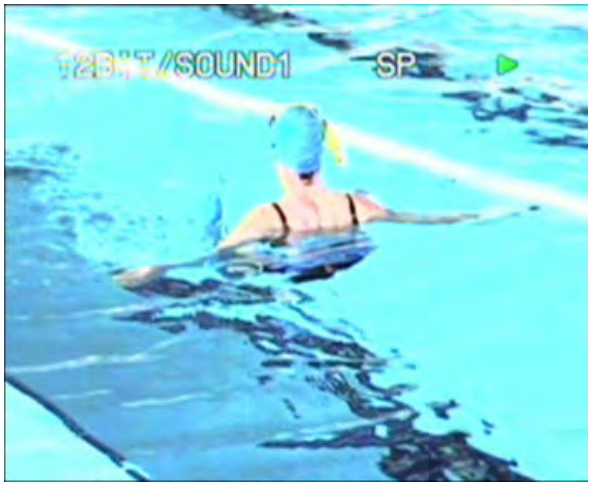




Others Aerobic water-based exercises







Others Aerobic water-based exercises