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Acute changes in blood pressure after resistance training with and without blood flow restriction

Picón Martínez M^a, Chulvi Medrano I^a, Cortell Tormo JM^a, Fernández Sáez J^b, Alexandre Alonso Aubin D^a

^aDepartment of General and Specific Didactics. University of Alicante. Spain;
^bPublic Health Research Group. University of Alicante. Spain.



Objective: The aim of this study was to compare the acute response on blood pressure after two different protocols, blood flow restriction resistance training vs non-restriction resistance training in normotensive young subjects.

Method: 52 subjects were assigned into three groups: High intensity (HI, 75%-1RM; n=15); low intensity (LI, 30%-1RM; n=13); and low intensity with blood flow restriction training (LI-BFR, 30%-1RM & 30% of total vascular restriction; n=24).

All participants performed four sets of plantar flexion exercise with 1 set of 30 repetitions following 3 sets of 15 (for LI and LI-BFR group) or 10 repetitions (HI group). Interset rest was performed with deflated cuff. Blood pressure (BP) was measured for 10 minutes prior to exercise (baseline), after last set of training and 15, 30, 45, 60 minutes after and 24 hours after exercise.

Results: In LI-BFR group, significant decreases ($p < 0.05$) in systolic blood pressure (SBP) occurred at 45 minutes (114 ± 17 mmHg) and 60 minutes (113 ± 15 mmHg) after exercise when compared with baseline value. Significant decreased in SBP occurred after 30 minutes (112 ± 14 mmHg) and 45 minutes (113 ± 10 mmHg) post-exercise in HI group.

Comparing the post-exercise values of SBP with the values after the last set of our intervention, it founds significant decreases after 60 minutes (113 ± 15 mmHg) for LI-BFR group and after 30 minutes (112 ± 14 mmHg) and 45 minutes (113 ± 10 mmHg) for HI. In LI group, there were no significant differences between measurements ($p > 0.05$).

Conclusion: Our results suggest that in young normotensive humans, HI resistance exercise and LI-BFR resistance training promote similar post-exercise hypotensive response.

Functional assessment of quadriceps muscle damage following acute inertial exercise.

Nuell S, Illera V, Carmona G, Padullés JM, Lloret M, Cadefau JA.

INEFC-UB. Biomedicine Department. Barcelona University. Spain.



Objective: The aim of the study was to investigate the degree of Exercise Induced Muscle Damage (EIMD) using Force Generating Capacity (FGC) and Creatine Kinase (CK) response after a single bout of eccentric-concentric (E-C) exercise.

Method: Eleven subjects (age 23.4 ± 3.8 y.o.) performed ten sets of ten repetitions of E-C bilateral squats on a flywheel inertial device (Yoyo Squat; Yoyo-Technology; Stockholm).

FGC measured as Maximal Voluntary Isometric Contraction (MVIC) of knee extensors, CK response and Delayed Onset Muscle Soreness (DOMS) were assessed before and 1h, 24h, 48h, 72h and 144h after exercise.

Results: Flywheel exercise caused a significant decrease in MVIC levels after exercise (-23.1% $p = .001$), after 24h (-18.7% $p = .002$). CK increased significantly from 203.7 U/L at the baseline to 909.4 U/L after 24h, 1030.8 after 48h and 947.7 after 72h. DOMS also increased significantly after exercise until 72h post exercise.

Conclusions: Despite the variability of the response to exercise between subjects the decrease in MVIC, the high levels of DOMS and the increase in CK suggest moderate muscle damage after this protocol of exercise. FGC seems the variable that recovers faster even some muscle damage still exists. From a practical point of view it should be taken into account that after high intensity inertial training between 48 and 72 hours are required to recover from EIMD.

Flywheel exercise training under constraints changes acceleration pattern variability and increases velocity of execution



Fernández-Valdés B^{a,d}, González J^b, Tous J^c, Vázquez J^b, Gisbert J^{a,d}, Moras G^a

^a National Institute of Physical Education of Catalonia, INEFC, Barcelona, Spain; ^b FC Barcelona, Barcelona, Spain; ^c Chelsea Football Club, Fulham, London, UK; ^d UE Santboiana Rugby, Spain.

Objective: To compare the structure of acceleration pattern variability and velocity of execution in elite rugby players ability to perform horizontal forward and backward resistance movement, using a rotational inertial device, over six weeks of training. The player catches and throws a rugby ball during forward movement.

Method: Eleven professional rugby players (mean \pm SD: age 25.5 \pm 2.0 years, height 1.83 \pm 0.06 m, weight 100.0 \pm 18 kg) participated in this study. Approximate entropy (ApEn) of acceleration signal and velocity of execution were analysed using a wireless inertial measurement unit (WIMU, Realtrack Systems, Spain) and rotary encoder (Chronojump, Spain) respectively.

Results: There were differences in ApEn between the first and the fifth and sixth week. The study also showed significant differences in the velocity of execution between the first and the third, fourth, fifth and sixth week.

Conclusions: The acceleration variability decreased and the velocity of execution increased with training. The use of nonlinear tools as ApEn could be an alternative to explore the nature of motion variability and its relation with skills development or injury factors. Note that ApEn measures variability without taking into account the magnitude of the variable. For this reason, we have used as a quantitative measure of training the velocity of execution. Thus, we could consider the combination of structure and magnitude to get the optimal movement variability when performing strength exercises with specific constraints.

Fatigue Variability Sliding Upon a Novel Slide Vibration Board: A Case Study



Gisbert Orozco JF, Fernández-Valdés Villa B, Rodríguez Jiménez S, Illera Domínguez V, Moras Feliu G.

Sport Performance Department, Institut Nacional d'Educació Física de Catalunya, Barcelona, Spain.

Objective: This study aimed to assess the effect of 30Hz and 0Hz vibration frequencies on trunk acceleration variability while sliding upon a novel slide vibration board (SVB) using Approximate Entropy (ApEn).

Method: Two amateur skaters physically active participated in this study. The study was conducted on a 2m SVB. Trunk acceleration of the subjects was measured using an inertial measurement unit (WIMU, Realtrack Systems, Almeria, Spain). Lactate was measured using a photometer (Diaglobal GmbH, Berlin, Germany). Approximate Entropy was calculated using the module of acceleration. The study was carried out on two days: on the first, subjects underwent a familiarization set and the exercise rhythm for each subject was obtained. Then, subjects performed one set at 0Hz vibration condition at their own rhythm until exhaustion. On the second, they performed one set at 30Hz vibration condition until exhaustion.

Results: ApEn decrease with exhaustion in both subjects (S1, S2) and conditions, for 0Hz (6% and 25%, respectively) and for 30Hz (19% and 16%, respectively). ApEn was greater at 30Hz than 0Hz conditions for both subjects (71%). Time to exhaustion was less at 30Hz than 0Hz for both subjects (28% and 31%, respectively). Lactate was higher at 30Hz than 0Hz for both subjects (8%).

Conclusions: Sliding on a SVB at 30Hz may be considered as a practical alternative to constrain the athlete than 0Hz stimulus. ApEn may be considered as a practical non-invasive alternative to assess fatigue. Further research it is necessary to understand learning process on the ApEn dynamics.

Power-work relationship across inertias in two different flywheel resistance exercises



Martínez-Aranda LM^{a,b}, Fernandez-Gonzalo R^{b,c}.

^a Faculty of Sport, San Antonio Catholic University of Murcia (UCAM), Murcia, Spain; ^b Muscle & Exercise Physiology Laboratory, Department of Physiology & Pharmacology, Karolinska Institutet, Stockholm, Sweden; ^c Department of Women's and Children's Health, Karolinska Institutet, Stockholm, Sweden.

Objective: To assess which is the most optimal inertial load (power/work output) in different exercise modes to prescribe specific iso-inertial training in injury recovery and prevention.

Methods: Eleven men (36.2 \pm 12.5 years) performed 2 sets of 3-4 repetitions of coupled CON-ECC actions using six different inertias during knee extension (unilateral) and leg press (bilateral) iso-inertial exercises. Real-time values of concentric power and total work were measured using BlueBrain™. Data were analysed for reliability and differences across inertias by using ANOVA. Effect sizes (ES) were also calculated.

Results: Reliability analysis (>0.9) reported no impact of the inertial order. Power decreased from lowest to highest inertia in both exercises, ~32-38% (ES= >1.5 and 1.05 for bilateral and unilateral exercises respectively). Work values showed an increment of ~45-40% (ES= >1.5 and 1.08) as higher inertias were used in both knee extension and leg press. The inertia 0.0375 kg*m² showed the best power-work ratio in the two exercise modes tested, with total work values of 343.4 and 801.4 J for unilateral and bilateral exercises, without important power losses when compared with lower inertias (<1-12%).

Conclusions: Considering the data obtained in this pilot study about power/work output ratio, the medium inertia (0.0375 kg*m²) seems the most optimal inertia, and a good starting choice for general purposes in both exercises. Although we must carefully interpret the results, this information could help sport and health professionals to better understand the role of inertial load in modifying the relationship of power-work in different flywheel resistance exercises.

Classification system for assessing lower back muscle endurance and muscular activity using eHealth technology.



Díaz-Reyes I^a, Damas M^b, Moral-Muñoz JA^c, Baños O^d.

^a MDURANCE SOLUTIONS S.L y Departamento de Arquitectura de los Computadores, Universidad de Granada. España; ^b Departamento de Arquitectura de los Computadores, Universidad de Granada. España; ^c Departamento de Enfermería y Fisioterapia, Universidad de Cádiz. España; ^d Departamento de Telemedicina, Universidad de Twente. Holanda.

Objective: This paper presents a new system that classifies lumbar electromyographic activity through an innovative digital health tool based on electromyography and data mining.

Method: A prospective study where 15 professional football players were recruited during the 2016/2017 preseason. MDurance was used to measure the resistance and muscular activity of the spinal erector. The tool consists of a portable sensor and a mobile / web platform where the electrical activity produced by any muscle is stored and evaluated.

To evaluate the erector stabilization, the Sorensen test was used once a week, before and after training up to a maximum of three times. Each player completed a questionnaire when performing the test to help the experts determine their state and muscle

capacity and relate the results to their physical perceptions to improve their performance.

Results: The results were grouped using clustering techniques, which grouped the values of muscle activity in minimum, medium and maximum. Subsequently a classifier was developed to predict RMS values in the execution of a new test. We obtained a classifier with an accuracy of 75.6%, a specificity of 83.8% and a sensitivity of 67.4%.

Conclusions. The results show that the groups obtained correspond to the values of muscular activity shown by the players and in most cases consistent with their perception. This system could be applied in functional assessment and verification of rehabilitation therapies and prevention of muscle fatigue in occupations activities.

The acute effect of the kinematic alterations produced in the increase of pace in endurance runners.

Molina-Molina A^a, Mercado-Palomino E^a, Delgado-García G^a, Richards J^b, Soto-Hermoso VM^a.

^a Department of Physical Education and Sport, Sport and Health University Research Institute (iMUDS), University of Granada, Granada, Spain; ^b Allied Health Professions Research Unit, Division of Physiotherapy and Sports Therapy, University of Central Lancashire, Preston, United Kingdom.



Objective: The aim of this preliminary study was to compare the acute effect of the alterations kinematics produced on the lower extremities when runners increase their pace speed to competition speed.

Method: 23 endurance runners were recruited; 12 males (height 176.58±4.93 cm, mass 72.46±6.97 kg) and 11 females (height 166.73±4.27 cm, mass 65.18±7.90 kg). Participants were tested at two different self-selected treadmill speeds, 1) comfortable pace, 2) competition pace for the dominant and non-dominant limbs. 3D kinematics were recorded for 16 seconds during each condition using 8 2MP cameras at 100Hz. Data were processed using Simi Motion v.9.2.0 (Simi Reality Motion Systems GmbH, Germany) and three dimensional ankle, knee and hip kinematics were calculated using Visual3D (C-Motion, Inc., Rockville, MD, USA). Spatiotemporal parameters were collected and measured using OptoGait system for 120s at 1000Hz.

Results: A two factor repeated measures ANOVA (speed and dominance) was performed on all data using SPSS (SPSS Inc., Chicago, IL, USA). Significant differences were seen between the treadmill speeds in ankle and hip joint kinematics but no differences were seen for knee joint parameters, or between dominant and non-dominant limbs.

Conclusions: Endurance runners often carry out high intensity interval training (HIIT) in their training programs. This data suggests that an increase of pace does not affect all joints equally. Such changes in speed could have implications to joint loads and levels of injury risk for different joints.

Optimal pressures for strength development by blood flow restriction training: a systematic review

Piepoli A^a, Plaza Florido A^b, Hita-Contreras F^a, Martínez Amat A^a

^a Department of Health Sciences, Faculty of Health Sciences, University of Jaén, Jaén, Spain; Research Group CTS-026: Study Group on Physical Activity, Physiotherapy, and Health, Jaén, Spain; ^b PROFITH "PRoMoting FITness and Healththrough physical activity" research group, Department of Physical Education and Sports, Faculty of Sport Sciences, University of Granada, Granada, Spain.



Objective: The aims of this systematic review were to find out the optimal levels of pressure for the improvement of muscle strength, to identify the variables that can influence the choice of

cuff pressure, and to describe pressure differences in lower- and upper-limb applications.

Method: The literature review was carried out from February to March 2017 in scientific databases (MEDLINE, SCOPUS) and sought to identify intervention studies which involved superimposed blood flow restriction (BFR) during strength training and were published between January 1st 2007 and May 1st 2017.

Results: The electronic search strategy produced 345 studies. A total of 22 articles met the inclusion criteria. In six of them pressure was established based on a percentage of resting arterial occlusion pressure (RAOP), in one it was based on the rate of perceived exertion (RPE), in another on the basis of the systolic blood pressure (SBP), and it was randomly determined in the rest. The studies included showed improvement in strength in both upper and lower limbs.

Conclusion: Current evidence suggests that, no optimum pressure values have been described to maximize the effects of training on muscle strength, but there is an optimal range of partial flow occlusion ranging from 50% to 80% RAOP. Finally, the results of flow restriction are strongly related to the width of the cuff used and to the circumference of the occluded limb.

'It's a matter of range': range of movement differences between elite and non-elite swimmers.

Cañizares M^{a,b}, Courel-Ibáñez J^{b,c}.

^a Elite Next Level, Madrid, Spain; ^b En-Forma, Granada, Spain; ^c Department of Physical Activity and Sport, Faculty of Sport Sciences, University of Murcia, Spain.



Objective: To analyse the differences in range of movement (ROM) between gender (male, female), age (U-15, U-17, senior) and competitive level (National team, regional club) in 82 swimmers. An adequate (ROM) helps to reduce injury risks and optimize technique, which leads to a better swimming performance. But, how decisive the ROM is to achieve the top-level in young competitive swimmers?

Method: The software ImageJ v.1.39n was used to measure joint angles in shoulder flexion, shoulder extension, plantar flexion and trunk flexion. Statistical analysis included Student-T test (male vs. female comparisons) and One-way ANOVA (within group's comparisons).

Results: Elite groups reported higher ROM in shoulder ($p<0.001$) and plantar flexion ($p=0.036$). Plantar flexion seemed to limit the progress towards the top-level from early ages (i.e., sub-15). Non-elite group showed larger gender differences, especially in shoulder flexion ($p=0.012$) and extension ($p<0.001$). Current findings may indicate the need for an optimum ROM to reach the elite in swimming. This is partly supported by previous research which found decrements in speed when limiting the ROM (i.e., functional bandage) in competitive swimmers. However, they did not find a correlation between ROM and speed. Further investigation to clarify the role of ROM in swimming performance at different ages and competitive levels is warranted.

Conclusions: Assessing ROM is very simple and practical for detecting potentially talented swimmers. The angle optimization and the ability to apply force at these ranges should be a main goal for S&C training in swimmers. We recommended an individualized mobility-based training for ROM improvement from early age.

Effects of a Probiotic on musculoskeletal-inflammation and muscle strength in healthy-older-men following an exercise program



Martinez Fernández VJ^a, Ramírez Pistón JM^b

^a Department of Pharmacology, Navarra University (Spain); ^b Department of Morphological Sciences, School of Medicine, University of Córdoba. Spain.

Objective: Growing evidence suggests that probiotics may have positive benefits on immune responses following endurance exercise. Little attention has been given to its possible beneficial effects on inflammation, pain and muscle strength following senior fitness and exercise programs. Inflammatory cytokines and acute phase proteins increase with ageing, promoting a chronic low-grade inflammation. Studies showed a positive effect of exercise on inflammatory markers in adults. Interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF- α) and C-reactive protein (CRP) are the main biomarkers investigated. It is unclear if exercise plus probiotics could decrease more all these biomarkers.

Methods: Twenty-four healthy sedentary men over 49 years old (49-58y) were recruited for a senior fitness and exercise program and randomised into two groups: Isotonic drink (C), isotonic drink plus probiotic formulation (Ex). Each training program comprised 4 days of cardiovascular activity and 2 days of strength training. Participants consumed either multi-strain probiotics (Lactobacillus Helveticus- 6×10^9 CFU+ Lactobacillus Rhamnosus- $1,2 \times 10^{10}$ CFU + Bifidobacterium Longum- 6×10^9 CFU) or placebo daily for 12 weeks. Performance of the knee extensors test (by isokinetic dynamometer) and numerical rating scale (NRS) for pain evaluation were assessed every week and blood samples of interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF- α) and C-reactive protein (CRP) were measured every 4 weeks.

Results: Statistical significant differences ($p < 0.05$) were observed in favour of Ex group regarding interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF- α) and C-reactive protein (CRP) and NRS for pain evaluation, starting from week 8 and keeping at week 12. Favourable differences were also detected with respect to muscular strength at week 12 but did not reach statistical significance.

Conclusions: Supplementing the diet of people who practicing sports with certain formulations of probiotics could improve the effects of physical exercise on so-called low-grade inflammation. It could also help to reduce muscle discomfort after exercise. More randomized trials are needed to demonstrate whether probiotics may have an effect on the reduction of sports injuries.