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ORAL ABSTRACT PRESENTATION

EFFECTS OF THE SET CONFIGURATION IN A CONCURRENT EXERCISE PROGRAM ON THE FORCE-VELOCITY RELATIONSHIP IN FRAIL OLDER PEOPLE

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Introduction: Concurrent exercise seems to be one of the best approaches to restore and/or maintain functional performance and reverse frailty. Thus, the aim of this study was to analyze force-velocity relationship changes in response to training programs differing in the set configuration (cluster vs. traditional), and its impact on physical function and frailty.

Methods: This was a quasi-experimental, non-randomized controlled intervention study in 44 (pre-) frail (Frailty Phenotype ≥ 1 criteria) older adults (81.40 ± 5.1 years). Patients were assigned to traditional (TT; $n = 13$), cluster (CT; $n = 11$) or control (CON; $n = 20$) group. TT and CON underwent a six-week concurrent training program which had the same training volume but not rest (TT: 1 minute between sets; CT: 10 seconds each 2 repetitions + 1 minute between sets) while CON followed usual care. F-V relationship, physical function and Frailty Phenotype were assessed at baseline and after training. Mixed model repeated measures ANOVA with Bonferroni's post-hoc tests were conducted to compare between-group differences over time. **Results:** Both groups showed similar improvements in Pmax after training (TT = +33.8W, $d = 0.44$; CT: = +37.7 W, $d = 0.49$; both $p < 0.05$). TT showed a tendency to improve F0 (+125.4 N, $d = 0.25$, $p = 0.06$) while no changes were observed in CT (+80.2N, $d = "0.15"$, $p > 0.05$). Finally, CT and TT improved SPPB (CT = +2.4 points, $d = 1.14$, $p < 0.05$; Frailty Phenotype = -0.2 criteria, $d = 0.05$, $p = 0.38$). **Conclusions:** Although both methodologies improved physical function and reduced frailty, cluster set configuration appears to be a more effective method to improve

velocity parameters on the F-V relationship, while the traditional one appears to be superior if the goal is to improve strength parameters. **Funding:** Ivan Baltasar-Fernandez: 2018-CPUCLM-7636; Francisco José García-García: CB16/10/00456; Ignacio Ara: CB16/10/00477. **References:** (1) García-García et al. *J Nutr Health Aging* 15(10): 852–6, 2011. (2) Losa-Reyna et al. *Exp Gerontol* 115: 114–121, 2019. **Mail to:** hector.soto@alu.uclm.es.

ORAL ABSTRACT PRESENTATION

USE OF INERTIAL MOTION UNITS TO STUDY MOTOR VARIABILITY DURING RESISTANCE MOVEMENTS

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Introduction: In recent years, resistance training monitoring has done important advances, which are allowing improving evaluation and prescription process in strength training. Among different tools that have appeared to monitor resistance training are the inertial motion units (IMU) for its lower cost and for the possibility to assess in different segments or instruments during strength movements (1). IMU can provide a lot of information from accelerometers or gyroscopes, and it is possible to study motor variability during human movement (2). This study aimed to assess the validity and sensitivity of IMUs to quantify different strength training loads through the analysis of motor variability. **Methods:** 21 healthy active participants performed 5 sets of 5 repetitions with different loads of one-repetition maximum in half squat movement (10, 30, 50, 70, and 90% of 1RM). Executions were done on a force plate (Kistler, Switzerland, Model 9287BA), and an IMU (STT-IWS, STT Systems, Spain) was placed in the bar. The possible relationships between the force plate and IMU signals were evaluated using the Pearson correlation coefficient, and an ANOVA were employed to compare force plate and IMU variables calculated, with the significance level set at 0.05. **Results:** Pearson correlation coefficient in different loads were between 0.716 and 0.942. ANOVA test did not show any difference when standard deviation or entropy were compared in the different loads for the half squat. **Discussion:** Results of the correlational analysis and ANOVA reinforce the possibility to use IMU to describe motor variability during resistance exercises. Keeping

in mind the low cost and portability of IMU devices comparing to force plate, coaches can employ IMU to evaluate motor variability during strength sessions and to monitor the changes after training programs. This research was funded by Ministerio de Ciencia, Innovación y Universidades, Gobierno de España: PID2019-109632RB-I00. **References:** (1) Sato, K., Smith, S. L., & Sands, W. A. Validation of an accelerometer for measuring sport performance. *The Journal of Strength & Conditioning Research* 23(1): 341–347, 2009. (2) Schütte, K. H., Sackey, S., Venter, R., & Vanwanseele, B. Energy cost of running instability evaluated with wearable trunk accelerometry. *Journal of Applied Physiology* 124; 462–472, 2018. **Mail to:** rsabido@umh.es.

ORAL ABSTRACT PRESENTATION

FROM THE PAPER TO THE GYM. ADAPTATION OF AN EXERCISE PROGRAM FOR FRAIL ADULTS

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Introduction: The aging of the world population is one of the biggest challenges to be faced by society, both economically and socially. Frailty is a geriatric syndrome characterized by a reduced capacity to respond to stressors, affecting 33% of people over 80 years and 11% over 65 years. The aim of our study was to adapt and transfer to real life the methodology and results obtained in a previous clinical trial intervention carried out by our research group (2). **Methods:** Fifty people over 75 years of age followed a multicomponent physical exercise program for 3 days a week over 6 months. In each session, strength exercises (45–75% maximum repetition), cardiorespiratory (55–75% maximum heart rate), balance, and joint mobility were trained. The main modifications of the original program occurred in the number of sessions per week, from 5 to 3, and the inclusion of all physical capacities in each session. The statistical analysis was done with the student's T test for paired samples and the Wilcoxon test for non-parametric samples. **Results:** Our results, show that the improvements achieved with the new intervention outweighs significantly those found in the clinical trial. We found that the real-life approach was superior in improving: frailty criteria ($p < 0.0001$), hand grip strength ($p = 0.0331$),

Tinetti gait and balance scale ($p = 0.0003$), number of falls ($p = 0.0073$), visits to the primary care center ($p = 0.0312$), Barthel scale ($p = 0.0001$) and Lawton scale ($p = 0.0011$). **Discussion:** We can conclude that the modifications included in the real-life intervention to adapt the exercise program to community dwelling old individuals have meant an improvement to the previous exercise program. **Acknowledgements and Financing:** This work was supported by Instituto de Salud Carlos III CB16/10/00435 (CIBERFES), (PID2019-110906RB-I00/AEI/10.13039/501100011033) from the Spanish Ministry of Innovation and Science; 109_RESIFIT from Fundación General CSIC. **References:** (1) Fried LP. Interventions for human frailty: Physical activity as a model. *Cold Spring Harb Perspect Med* 6(6): 1–14, 2016. (2) Tarazona-Santabalbina FJ, Gómez-Cabrera MC, Pérez-Ros P, Martínez-Arnau FM, Cabo H, Tsaparas K, et al. A Multicomponent Exercise Intervention that Reverses Frailty and Improves Cognition, Emotion, and Social Networking in the Community-Dwelling Frail Elderly: A Randomized Clinical Trial. *J Am Med Dir Assoc [Internet]* 17(5): 426–33, 2016. Available from: <http://dx.doi.org/10.1016/j.jamda.2016.01.019>. **Mail to:** fernando.millan.domingo@gmail.com.

POSTER ABSTRACT PRESENTATION

TESTOSTERONE PROFILE THROUGHOUT THE MENSTRUAL AND THE ORAL CONTRACEPTIVE CYCLE

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Introduction: Testosterone fluctuations over the menstrual and oral contraceptive cycle, as well as hormonal differences between eumenorrheic and OC users, may affect performance. In line with that, high testosterone levels are suggested to enhance competitive desire and motivation (1), and to increase risk-related choices during competition (2), especially in high-performance athletes. However, differences between both hormonal profiles have not been previously studied. Therefore, the aim of this study was to examine serum testosterone levels over menstrual and OC cycle phases, and to compare this variable between both hormonal profiles in trained women. **Methods:** Thirty-nine eumenorrheic females (30.0 ± 6.3 years; 59.8 ± 15.7 kg; 163.7 ± 6.3 cm) and 24 OC users (25.1 ± 4.3 years; 56.2 ± 10.9 kg; $163.1 \pm$

5.5 cm) participated in this study. Testosterone and bioavailable testosterone were measured in the early follicular, late follicular, and mid-luteal phases (EFP, LFP, MLP, respectively) of the menstrual cycle, and in the withdrawal and active pill phases (WP and APP, respectively) of the OC cycle. A mixed linear model was performed to compare cycle phases within each group and between the 2 hormonal profiles. The significance level was set at $p < 0.05$. **Results:** Higher testosterone and bioavailable testosterone values were observed in the LFP (0.31 ± 0.22 and 0.07 ± 0.01 ng·dl⁻¹, respectively) compared to the EFP (0.21 ± 0.02 and 0.05 ± 0.00 ng·dl⁻¹) and to the MLP (0.24 ± 0.02 and 0.05 ± 0.01 ng·dl⁻¹) ($p < 0.001$). For the same variables, higher levels were observed in the WP (0.33 ± 0.04 and 0.04 ± 0.01 ng·dl⁻¹) than in the APP (0.27 ± 0.03 and 0.03 ± 0.01 ng·dl⁻¹) ($p = 0.019$). Finally, no significant differences between eumenorrheic and OC users were observed for testosterone, but higher levels of bioavailable testosterone were shown in the LFP in comparison to the APP ($p < 0.001$). **Discussion:** The LFP of the menstrual cycle and the WP of the OC seem to be key moments when higher testosterone levels might lead to different physiological responses and/or training adaptations. Additionally, testosterone bioavailability in the LFP in eumenorrheic women in comparison to the APP in OC users, may also confer a potential advantage (3), which could be of interest to coaches in order to gain a better understanding of women's physiology in an attempt to improve performance outcomes. **Funding:** DEP2016-75387-P. **References:** (1) Crewther BT, Cook CJ. *Physiol Behav*. 2018;188:157–61. (2) Cook CJ, Crewther BT. *Horm Behav* 112: 77–80, 2019. (3) Ahmetov II, et al. *I J Sports Med Phys Fitness* 60(10): 1377–82, 2020. **Mail to:** romero.nuria2010@gmail.com.

ORAL ABSTRACT PRESENTATION

SEX-RELATED DIFFERENCES IN THE SECOND LACTATE THRESHOLD

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Introduction: Women present higher fat oxidation at the same relative intensity compared to men. On the other hand, blood

lactate concentration influences fat oxidation (2), so it is hypothesized that lactate kinetics may differ between male and females. Thus, the aim of this study was to assess the differences in lactate kinetics between male and female athletes. **Methods:** Nine trained males (23.88 ± 4.51 years, 72.5 ± 6.79 kg and 176.41 ± 5.14 cm) and 12 trained females (19.81 ± 2.18 years, 58.4 ± 8.03 kg and 164.69 ± 8.14 cm) were selected. All with the AA genotype for the T1470A polymorphism of the MCT1 gene (to avoid this moderate genetic factor) (3,4). Genotyping was performed using real-time PCR. All participants completed an incremental cycle test (35W increase every 3 minutes) until exhaustion, while capillary blood lactate concentration was analysed (Lactate Plus, Germany) at rest, in the last 30" of each step and immediately post-test. Second lactate threshold (LT) was determined via D-max method (5). Lactate level at the LT ($\text{mM} \cdot \text{L}^{-1}$) expressed as percentage of the maximal lactate, as well as power output at LT (W) expressed as a percentage of the maximal power were compared between sexes using a Mann-Whitney U test. **Results:** Percentage of LT lactate relative to maximal lactate was higher in females ($54.51 \pm 15.23\%$) compared to males ($43.52 \pm 5.77\%$) ($p = 0.018$), whereas no significant differences in power output relative to maximal power output ($p = 1.000$) were observed between sexes (females: $70.12 \pm 7.99\%$ and males: $70.45 \pm 6.35\%$). Regarding maximal lactate, there were no significant differences between the sexes ($p = 0.602$) (females: 10.95 ± 2.47 $\text{mM} \cdot \text{L}^{-1}$ and males: 11.65 ± 2.28 $\text{mM} \cdot \text{L}^{-1}$). **Discussion and Conclusion:** Our findings suggest that lactate threshold occurs nearer to the maximal lactate in females compared to males. This suggests that, at the same submaximal power intensity, women rely on oxidative metabolism more than men. This is in agreement with previous results reporting higher fat oxidation rate in females compared to males at the same submaximal relative intensity (1). Possible explanations for this are the inhibition of fat oxidation by lactate (2) or the higher percentage of slow muscle fibers in women (6). More studies are needed to further explain these metabolic differences between sexes. Thus, trainers and coaches should consider the metabolic difference when prescribing exercise based on power output if they want to stimulate similar metabolic adaptations. **Funding:** PIN-V18ENW9ML92B2287R. **References:** (1) Hunter SK.2015. DOI:10.1152/jappl.1998.85.5.1823. (2) Brooks GA.2018. DOI:10.1016/j.cmet.2018.03.008. (3) Hawkins WC.2020. DOI:10.1249/01.mss.0000685576.90786.59. (4) Fedotovskaya ON.2014. DOI:10.1123/IJSP.2013-0026. (5) Cheng B.1992. DOI: 10.1055/s-2007-1021309. (6) Haizlip KM.2015. DOI:10.1152/physiol.00024.2014. **Mail to:** jbenitez020@gmail.com.

ORAL ABSTRACT PRESENTATION

EFFECTS OF CONCURRENT TRAINING AND DETRAINING ON PHYSICAL FUNCTION, MUSCLE POWER, FRAILTY AND INDEPENDENCE IN ACTIVITIES OF DAILY LIVING IN FRAIL OLDER ADULTS

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Introduction: The combination of endurance and resistance training improves physical performance and reduces frailty in older people (1). However, whether these positive adaptations are maintained in the long term in the absence of exercise training in frail older adults is unknown. This study aimed (a) to assess the effects of a six-week concurrent exercise program (power training and high-intensity interval training) on physical function, muscle power, frailty and independence in activities of daily living in frail older people, and (b) to assess the effects of a six-month detraining period on these outcomes. **Methods:** A total of 59 frail and pre-frail older adults (>75 years; Fried's criteria ≥ 1) were divided into an intervention (INT; $n = 32$) and a control (CON; $n = 27$) group. Primary outcomes were the short physical performance battery (SPPB) score, relative sit-to-stand (STS) power (2), Fried's frailty criteria, Barthel index, and Lawton scale. Assessments were performed in both groups at baseline, after the concurrent training program, and after 6 months of follow-up. Mixed model repeated measures ANOVA with Bonferroni's post hoc tests were used to assess changes at each time point and to compare both groups. **Results:** INT improved SPPB ($\Delta = 3.0$ points; $p 0.05$). In addition, there were significant differences in SPPB (9.7 ± 1.9 vs. 7.8 ± 2.5 points; $p < 0.001$), relative STS power (2.92 ± 0.53 vs. 2.40 ± 0.60 W·kg⁻¹; $p < 0.001$) and frailty (1.58 ± 1.28 vs. 2.68 ± 1.36 criteria; $p < 0.001$) between INT and CON after, but not before, the exercise program. After 6 months of detraining, INT showed higher SPPB ($\Delta = 2.2$ points; $p < 0.001$), higher relative STS power ($\Delta = +0.73$ W·kg⁻¹; $p < 0.001$) and lower frailty ($\Delta = -1.24$ criteria; $p < 0.001$) values than those reported at baseline, which were significantly different from those reported by CON (all $p < 0.05$). Barthel index and Lawton scale values did not change significantly during the study in any of the groups. **Conclusions:** A six-week program composed of power training and high-intensity interval training improved physical function, muscle power, and

reduced frailty in frail older people, and these improvements were maintained above baseline levels after 6 months of detraining.

References: (1) Losa-Reyna et al. *Exp Gerontol* 115: 114–121, 2019. (2) Alcazar et al. *Exp Gerontol* 112: 38–43, 2018.

Funding: Ivan Baltasar-Fernandez: 2018-CPUCLM-7636. Francisco José García-García: CB16/10/00456. Ignacio Ara: CB16/10/00477. **Mail to:** ivan.baltasar@uclm.es.

ORAL ABSTRACT PRESENTATION

INFLUENCE OF THE MENSTRUAL CYCLE ON CRAWL PERFORMANCE IN YOUNG FEMALES SWIMMERS

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Introduction: Hormonal fluctuations during the phases of the menstrual cycle can influence athletic performance. Recently, results have been found that recommend adopting a personalized approach based on each individual's response to exercise performance throughout the menstrual cycle (2). In particular, it has been suggested that in female 200-m swimmers taking a monophasic oral contraceptive can perform equally regardless of their menstrual phase (3). **Purpose:** To determine the influence of the phases of the menstrual cycle on swimming performance, analyzing variation in performance of the different variables (time, cycle frequency, and cycle length). **Methods:** We recruited 11 female swimmers of regional category 20.63 (2.01) years; 169 (0.75) cm; 59.32 (6.69) kg, and 20.78 (1.76) kg·m⁻². The sample went to the pool in the 3 phases of the menstrual cycle (menstrual phase [MP]), follicular phase (FP), and luteal phase (LP) to perform a 2 × 50 test with 5 minutes of recovery doing crawl. The 50-meter time (T50), cycle frequency (CF), cycle length (CL), mean velocity (MV), and fatigue index (FI) were analyzed. **Results:** The analysis revealed significant differences in performance as a function of menstrual cycle phase. (1) MP vs. FP: - improvement -T50 - and CF; (2) MP vs. LP: improvement CL; (3) FP vs. LP: - improvement CL and - FI ($p < 0.05$). **Conclusions:** The different phases of the menstrual cycle influence on crawl performance in young regional female swimmers. Based on the variables analyzed, FP was the optimal phase. It is not clear whether there is a direct influence on swimming performance depending on the menstrual phase, attributing this fact to possible interindividual differences (2,4). **References:** (1) Constantini N, Dubnov G, Lebrun C. The menstrual cycle and

sport performance. *Clinics in sports medicine* 24(2), 2005. (2) McNulty KL, Elliott-Sale KJ, Dolan E, Swinton PA, Ansdell P, Goodall S, et al. The Effects of Menstrual Cycle Phase on Exercise Performance in Eumenorrhic Women: A Systematic Review and Meta-Analysis. *Sports Medicine* 50(10): 1813–27, 2020. (3) Rechichi C, Dawson B. Oral contraceptive cycle phase does not affect 200-m swim time trial performance. *Journal of Strength and Conditioning Research* 26(4): 961–7, 2012. (4) Bruinvels G, Burden RJ, McGregor AJ, Ackerman KE, Dooley M, Richards T, et al. Sport, exercise and the menstrual cycle: where is the research? *British Journal of Sports Medicine* 51(6): 487–8, 2017. **Mail to:** dariorodrigom@gmail.com.

POSTER ABSTRACT PRESENTATION

THE MOST USED EXERCISES IN THE MOST CITED RESISTANCE TRAINING RELATED STUDIES (2000–2019)

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Introduction: The benefits of resistance training on health and sports performance (2) are widely known. Exercise selection is a key aspect to consider when designing any given resistance training programme (3). Whether previously evidenced benefits desire to be replicated, priority in exercise selection should be given to those exercises that have been used in the most cited studies. Therefore, this study aimed to analyze which exercises were commonly used in the most cited strength exercise-related studies. **Methods:** A review of the 100 most cited studies regarding strength exercise training was performed. A search on an electronic database (Web of Science) using the terms “strength training,” “resistance training,” and “weight training” was conducted to identify all publications related with resistance training interventions. Studies had to be performed on human beings, employing external gravitational resistance, and with an intervention duration longer than 4 weeks. Only the exercises adequately described were compiled. Data was processed grouping exercises variants in such a way that the final result would give a clear picture of the issue. **Results:** Seventy-two studies satisfied the inclusion criteria. A total of 442 exercises were reported, resulting in an amount of 105 different exercises, where 48 were used in at least 2 different studies. The exercises most frequently mentioned in the litera-

ture were the leg extension (11.8%), leg press (11.3%), and leg curl exercise (7.0%). The most used upper limb exercises were the lat pulldown (6.3%), biceps curl (4.8%), and bench press exercise (3.8%). **Discussion:** The most utilized exercises were weight-stack (i.e., guided) lower limb exercises. This may be due to an easier standardization of the execution. Nevertheless, scientific considerations given by researchers may differ from those obtained by a strength and conditioning coach or a certified professional. Therefore, methodological considerations limit the use of certain sport-specific exercises in experimental research, although they are highly used in the applied field. Which in turn means a gap between both dimensions, that should be addressed to effectively prescribe exercise for any given resistance training program. **References:** (1) Westcott WL. Resistance training is medicine: effects of strength training on health. *Current sports medicine reports* 11(4): 209–16, 2012. (2) Suchomel TJ, Nimphius S, Bellon CR, Stone MH. The Importance of Muscular Strength: *Training Considerations*. *Sports medicine* 48(4): 765–85, 2018. (3) Kraemer WJ, Nitka M. Variables in Designing a Workout. *Strength & Conditioning Journal* 43(3): 127–8, 2021. **Mail to:** alvaro.villaverdecastrillo@gmail.com.

ORAL ABSTRACT PRESENTATION

ANALYSIS OF PULMONARY FUNCTION AND PHYSICAL CONDITION IN ADULT CYSTIC FIBROSIS PATIENTS

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Introduction: Improved pulmonary function and physical condition are known to be prognostic variables for the progression of cystic fibrosis, associated with fewer pulmonary exacerbations and lower risk of hospitalization (1,2,3). Given the increase in life expectancy in these patients over the last decade, there is a need to evaluate these variables and implement interventions to improve them. Furthermore, metabolic and contractile muscular alterations are also present in these patients, thus it is necessary to evaluate their functionality, both at respiratory and peripheral muscle level (4). Therefore, the aim of this study was to analyze the pulmonary function and cardiorespiratory

and muscular physical condition of adult patients with CF.

Methods: Forty-four adult CF patients from Hospital Universitario de La Princesa participated in this study. A descriptive analysis of forced expiratory volume 1 s (FEV1) analyzed by spirometry, peak oxygen consumption ($\dot{V}O_{2peak}$) analyzed by ergospirometry with a treadmill incremental test was performed. Inspiratory muscle strength was measured by maximum inspiratory pressure (MIP) and strength of upper and lower limbs was evaluated by a hand-grip strength test and a 30-second chair stand test (CS-30), respectively. **Results:** Subjects mean age was 31.7 ± 8.75 years old and BMI was 22.33 ± 2.51 kg·m⁻². FEV1 mean was 2404.05 ± 940.84 ml, MIP was 125.10 ± 48.28 cm₃H₂O. Mean $\dot{V}O_{2peak}$ was 30.67 ± 9.33 ml·kg⁻¹·min⁻². Right hand grip strength was 30.82 ± 10.04 kg and in the CS-30 test 25.43 ± 6.05 repetitions. **Discussion:** In this group of subjects, physical exercise has been part of their treatment since childhood, obtaining that 88.6% of the sample remains physically active. 13.6% of patients presented a mild decline of pulmonary function, 20.5% moderate, 9.1% moderate-severe and 27.3% severe. The remaining subjects presented a FEV1 $\geq 80\%$. Most of the subjects (72.4%) maintained a normal inspiratory muscle (5). Regardless of their pulmonary pathology, 50% of the patients presented a $\dot{V}O_{2peak}$ considered as “fit” ($\geq 82\%$ predicted) for healthy populations (6). For peripheral muscles strength, mean results obtained in the sample are close to healthy/normal reference values. **Conclusion:** Even though subjects have a decline in pulmonary function typical of CF disease, they manage to maintain cardiorespiratory capacity and muscular strength around normal values. Therefore, it seems recommendable to implement a strength physical training program in addition to cardiorespiratory exercise in order to keep this population in good physical condition. **References:** (1) Kampouras A, et al. (2021); (2) Vendrusculo FM, et al. (2019); (3) Pérez M, et al.; (2014); (4) Vendrusculo FM, et al. (2021); (5) Black L & Hyatt R (1969); (6) Burghard M, et al. (2021). **Mail to:** tamara.iturriaga@gmail.com.

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ORAL ABSTRACT PRESENTATION

CROSS-SECTIONAL ANALYSIS OF THE INFLUENCE OF ANTENATAL AND POSTPARTUM PHYSICAL ACTIVITY LEVELS ON STROKE VOLUME

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Introduction: Increased physical activity levels positively influence cardiovascular adaptations in the antenatal and postpartum periods, leading to decreased risk of pre-eclampsia and hypertension (1). There are marked adaptations in stroke volume (SV) during antenatal/postpartum periods (2), though little is known regarding the influence of PAL on these adaptations. Understanding whether antenatal/postpartum PAL influence SV is required to identify and inform safe physical activity (PA) and exercise behaviours during and following pregnancy. Therefore, this study sought to investigate the influence of PAL on SV in the antenatal and postpartum periods. **Methods:** Sixty-eight pregnant women participating in the “PE-CAMP” randomised controlled trial underwent physiological assessments at 18–22 (T2) and 33–37 (T3) weeks gestation, and at 12–16 weeks postpartum (PP). Self-reported habitual PAL using the modified physical activity questionnaire were recorded from 3 months prior to pregnancy, during each pregnancy trimester and up to 3 months postpartum. SV was continuously recorded using the Task Force Haemodynamic Monitor at rest (5 minutes) and during exercise on a cycle-ergometer at a workload equivalent to 40–60% heart rate reserve (10 minutes). Cross-sectional multiple regression analyses investigated the influence of PAL on SV at rest and during exercise at T2 ($n = 64$), T3 ($n = 55$), and PP ($n = 40$). Age and total time spent in minutes in moderate- and vigorous-intensity PA in the time-point specified above were included in the model. **Results:** The model explained 21.4% of the variance in rest SV in T3 ($F(5, 54) = 2.668$); $p = 0.033$) and 58.3% of the variance in SV during exercise in PP ($F(5, 39) = 2.506$); $p = 0.012$). The strongest predictors of rest SV during T3 were time spent in moderate and vigorous PA in the third trimester, although they failed to reach significance. The key determinants of SV during exercise at PP were time spent in vigorous PA in the third trimester ($\beta = 0.482$; $p = 0.002$) and moderate PA 3 months postpartum ($\beta = 0.400$; $p = 0.010$). **Discussion:** These findings highlight the importance of promoting moderate and vigorous PA for cardiovascular health during and after pregnancy. **Practical Application:** Moderate and vigorous PA can be safely prescribed to active women in their third trimester of pregnancy and in the postnatal period. **Acknowledgement:** This project received funding from the European Union’s Horizon 2020 Research and Innovation programme. Marie Skłodowska-Curie grant agreement No 663830-SU-079. **References:** (1) Mottola MF, Davenport MH, Ruchat SM, Davies GA, Poitras VJ, Gray CE, et al. *Br J Sports Med* 52(21): 1339–46, 2018. (2) Fu Q. *Adv Exp Med Biol* 1065: 413–31, 2018. **Mail to:** olga.roldanreoyo@swansea.ac.uk.

ORAL ABSTRACT PRESENTATION

EFFECTS OF ECCENTRIC TRAINING ON POWER AND VELOCITY DURING HALF-SQUAT IN ATHLETES WITH PATELLAR TENDINOPATHY**SAN JUAN A.F.,¹ SÁNCHEZ-GÓMEZ A.,² RUIZ-CAÑETE M.,³ AND DOMÍNGUEZ R.^{4,5}**¹*Departamento de Salud y Rendimiento Humano, Facultad de Ciencias de la Actividad Física y del Deporte-INEF, Universidad Politécnica de Madrid, Madrid, España;*²*Departamento de Enfermería Farmacología y Fisioterapia, Facultad de Medicina y Enfermería, Universidad de Córdoba, Córdoba, España;*³*Centro Andaluz de Medicina del Deporte, Córdoba, España;*⁴*Departamento de Motricidad Humana y Rendimiento, Universidad de Sevilla, Sevilla, España;*⁵*Studies Research Group in Neuromuscular Responses (GEPREN), Universidade Federale de Lavras, Lavras, Brasil*

Introduction: Patellar tendinopathy is an injury which causes pain, as well as loss of strength and sport performance levels. It is highly prevalent in sports modalities that involve jumps, sprints, and changes of direction (1). Eccentric exercise (EE) using declined single-leg squats has been shown to be one of the most effective treatments to reduce pain and restore functional capacity in PT (2). However, to our knowledge, any research has investigated the effect of EE on the power-velocity relationship. **Objective:** Evaluate the effectiveness of an eight-week recovery-training program on maximum power (Pmax), and velocity at Pmax (VPmax) in half-squat in athletes with PT. **Methods:** Eight athletes (6 men and 2 women) with PT, performed 8 weeks of EE: 3 sets of 10 repetitions of 25° declined single-leg squat, twice per day. Before and at the end of each session, they performed 30 seconds of static stretching of knee flexors and extensors. In addition, during the first 4 weeks they received shock wave treatment. At the beginning (PRE) and at the end of the eight-week intervention (POST), all the subjects performed a half-squat progressive load test to determine Pmax and VPmax with a linear encoder. Shapiro-Wilk's test was used for contrasting the normality distributions of the variables. A Student t test for related samples analyzed the differences between PRE-POST. Effect size (ES) was determined using Cohen's *d*, considering values >0.80 as large, 0.5–0.8 moderate, 0.2–0.5 small, and <0.2 trivial. Statistical significance was set at $p < 0.05$. **Results:** At POST, we observed a significant improvement in Pmax from PRE (+28%; $p < 0.05$), and no differences in VPmax between PRE and POST ($p > 0.05$; ES < 0.20). **Discussion:** These preliminary results showed that an eight-week EE program in combination with stretching and shock waves, allowed to improve Pmax in half-squat in patients with PT. Further, it

seems that the relationship between Pmax and VPmax in half-squat is not affected during recovery in athletes with PT. Our results agree with González-Badillo and Sánchez-Medina (3) in healthy subjects. **Practical Application:** The relationship between Pmax and VPmax remains constant and the improvements in Pmax production after the recovery of the PT seems to be only due to an improvement in the load displaced and not to changes in the velocity of movement. **References:** (1) Andarawis-Puri et al. *J Orthop Res* 33: 780–784, 2015. (2) Malliaras et al. *Sports Med* 43: 267–286, 2013. (3) González-Badillo JJ, Sánchez-Medina L. *Int J Sports Med* 31(5): 347–52, 2010. Mail to: alejandro.sanjuan@upm.es.

ORAL ABSTRACT PRESENTATION

RESISTANCE TRAINING IN HYPOXIA IMPROVES THE BONE HEALTH OF OLDER ADULTS**TIMÓN R., MARTÍNEZ-GUARDADO I., CAMACHO-CARDEÑOSA M., CAMACHO-CARDEÑOSA A., VASQUEZ-BONILLA A., GONZÁLEZ-CUSTODIO A., LEAL A., AND OLCINA G.**¹*Faculty of Sport Sciences, University of Extremadura, Cáceres, Spain;* ²*Faculty of Life and Natural Sciences, Nebrija University, Madrid, Spain;* and ³*Medical Center Alejo Leal, Cáceres, Spain*

Introduction: Resistance training has been recommended as a strategy to prevent osteoporosis and sarcopenia in older adults. Hypoxic training has been suggested as a beneficial therapy that could have an added synergistic effect with resistance training to improve muscle strength and bone health (2). The aim of this study was to evaluate the effects of the resistance training in hypoxic conditions on the bone health of the older adults. **Methods:** A total of 60 older adults (65–75 years) were randomly divided into 4 groups: normoxia without training (NOR), resistance training in normoxia (RTN), hypoxia exposure without training (HIP), resistance training in hypoxia (RTH) (at a simulated altitude of 2500 m asl; FIO₂ = 16.1%). The resistance training lasted 24 weeks and consisted of a full-body workout with elastic bands and kettlebells (3 × 12–15 reps). Bone mineral density (BMD) and bone mineral content (BMC) were measured by DEXA at baseline and after the intervention. Likewise, sensitive serum biomarkers of bone turnover of bone formation (PINP) and bone resorption (B-CTX) were also analyzed. A two-way ANOVA with Bonferroni post hoc tests were used to investigate the main and interaction effects. **Results:** Findings showed that the training factor had a significant main effect on the biomarkers of bone turnover after the intervention. An interaction effect of the training and hypoxia factors on the levels of these biomarkers was also observed.

However, no significant change in BMD and BMC values was observed after the training program. **Discussion:** The effects of hypoxic conditioning on bone health in older adults could depend on the duration of the intervention, severity, and time of exposure (3). Resistance training in hypoxia during 24 weeks causes positive effects on the bone turnover, although changes in BMD and BMC would need longer interventions. **Funding:** This study has been co-financed by the Junta de Extremadura (IB18010) and by the European FEDER funds. **References:** (1) Hong AR, Kim SW. Effects of Resistance Exercise on Bone Health. *Endocrinol Metab* 33(4): 435–444, 2018. doi:10.3803/EnM.2018.33.4.435. (2) Scott BR, Slatery KM, Sculley D V, Dascombe BJ. Hypoxia and resistance exercise: a comparison of localized and systemic methods. *Sport Med* 44(8): 1037–1054, 2014. doi:10.1007/s40279-014-0177-7. (3) Gangwar A, Paul S, Ahmad Y, Bhargava K. Intermittent hypoxia modulates redox homeostasis, lipid metabolism associated inflammatory processes and redox post-translational modifications: Benefits at high altitude. *Sci Rep* 2020, 10 (1):7899. doi:10.1038/s41598-020-64848-x. **Mail to:** rtimon@unex.es.

POSTER ABSTRACT PRESENTATION

RESISTANCE TRAINING INTENSITY: WHICH IS THE MOST USED INTENSITY MARKER IN THE MOST CITED STUDIES?

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Introduction: Resistance training intensity has been traditionally prescribed based on the one-repetition maximum (1RM) (1). However, throughout the scientific literature, not only the percentage of the 1RM (%1RM) or the maximal number of repetitions a load can be lifted (RMs) methods have been used but also other intensity markers, such as subjective perception of effort (RPE) (2) or movement velocity (3), have been proposed. This study aimed to analyze the presence of the different intensity markers used in the most cited studies in order to identify the most used method. **Methods:** A review of the 100 most cited articles by five-year bands (2000–2004; 2005–2009; 2010–2014; 2015–2019) was performed in the Web of Science database using the terms “strength training,” “resistance training,” and “weight training.” Studies conducted in humans with a resistance training intervention longer than 4

weeks using external gravitational resistance with an adequately exercise intensity marker description were included. When 2 or more intensity markers were used in the same study, these markers were counted with a relative value corresponding to the total number of intensity markers. **Results:** A total of 89 articles met the inclusion criteria. The RMs method was the most used (44.9%), followed by %1RM (41.6%). Other intensity markers such as RPE (3.9%), percentage of the XRM (3.4%), exercise velocity (2.3%), absolute weight (1.6%), percentage of body weight (1.1%), or percentage of maximal voluntary isometric contraction (1.12%) had a lower presence. The marker RMs and %1RM were also the most used intensity markers by year bands (2000–2004: 50.0 and 36.7%; 2005–2009: 50.9 and 41.1%; 2010–2014: 25.0 and 60.7%; 2015–2019: 44.1 and 35.2%, respectively). **Discussion:** Traditional strength exercise intensity markers, such as RMs and %1RM, have been the most used methods in the most cited resistance training related literature. Despite the development of new strategies, such as velocity-based training or RPE, these alternative intensity markers have been less used in scientific literature. Future research should analyze whether, due to technology expansion, these alternative markers are increasing its presence in science and how they are implemented into practical application. **References:** (1) Haff & Triplett. Essentials of Strength Training and Conditioning fourth edition: Human kinetics; 2015. (2) Zourdos et al. Novel resistance training-specific rating of perceived exertion scale measuring repetitions in reserve. *J Strength Cond Res* 30(1): 267–75, 2016. (3) Weakley et al. Velocity-Based Training: From Theory to Application. *Strength Cond J* 43(2): 31–49, 2021. **Mail to:** msierra7285@alumnos.uemc.e.

POSTER ABSTRACT PRESENTATION

IS INFLUENCED THE MAXIMAL FORCE CAPACITY ON ISOKINETIC ASSESSMENT BY BLOOD FLOW RESTRICTION?

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Introduction: Blood flow restriction (BFR) training has emerged as an effective alternative to conventional training (1). Recently, it has been suggested that BFR does not generate any neuromuscular benefit on the force-velocity profile (2,3,4). These studies included multijoint exercises (e.g., squat and bench press) monitored with linear encoders. And it has

been suggested that the effects of BFR could be induced by a "rebound" effect generated mainly by the cuff pressure. To our knowledge, the influence of BFR on maximal force production in isokinetic tests has not been studied often. **Purpose:** The aim was to evaluate changes in the ability to generate maximal force in knee extension at different velocities using an isokinetic device during the application of low-intensity BFR (40% of maximal pressure occlusion [MPO]). **Methods:** A total of 37 physically active adults [33.73 (10.96) years; 172.19 (9.65) cm; 65.72 (10.55) weight; 22.11 (2.79) $\text{kg}\cdot\text{m}^{-2}$] participated in the study by performing knee extension exercise with isokinetic dynamometry in 3 conditions (120, 210, and $300^{\circ}\cdot\text{s}^{-1}$), applying BFR at 40% of maximum arterial occlusion (BFR40) and without BFR (BFR0). The isokinetic variables analyzed were peak torque, average torque and mean power. **Results:** No significant differences were found for any of the neuromuscular variables in any velocity condition ($p < 0.05$). Peak torque (N·m) BFR0: $120^{\circ}\cdot\text{s}^{-1} = 158.92$ (46.39), $210^{\circ}\cdot\text{s}^{-1} = 123.11$ (37.93), and $300^{\circ}\cdot\text{s}^{-1} = 120.8$ (136.19); vs. BFR40: $120^{\circ}\cdot\text{s}^{-1} = 175.83$ (151.95), $210^{\circ}\cdot\text{s}^{-1} = 120.81$ (36.87), and $300^{\circ}\cdot\text{s}^{-1} = 104.11$ (31.05). **Conclusions:** Superimposed application of low-intensity BFR (40% MPO) on knee extension of the dominant leg of healthy young men did not generate any change on the ability to generate maximal force in isokinetic tests. Given the benefits attributed to these loads on neuromuscular gains, the use of RFS with low loads may be an applicable tool in situations of low contractile capacity and/or recovery phases of the athlete aimed at maintaining maximal strength levels. **Keywords:** resistance training, partial vascular occlusion, acute responses, muscle performance. **References:** (1) Lixandrão et al. *Sports Medicine* 48(2): 361–78, 2018. (2) Gefpert et al. *International Journal of Environmental Research and Public Health* 17: 4674, 2020. (3) Wilk et al. *Frontiers in Physiology* 11: 1471, 2020. (4) Wilk et al. *International Journal of Environmental Research and Public Health* 17: 3752, 2020. **Mail to:** darioRodrigom@gmail.com.

POSTER ABSTRACT PRESENTATION

INFLUENCE OF FOOTBALL MATCH-PLAY ON ISOMETRIC KNEE FLEXION STRENGTH AND HIP ROM IN FOOTBALL REFEREES

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Introduction: Football is an explosive team sport, where referees and assistant referees cover around 11–12 km of which approximately 10% is performed at high intensity (i.e., >18 km) (1). Elite referees and assistant referees may officiate up to 40 matches per season, thus the combination of acute and chronic loads in elite football refereeing may lead to fatigue and to a high risk of injury, particularly during congested calendars (2). The aim of this study was to examine the acute effect of officiating a football (soccer) match on isometric knee flexion strength and passive hip flexion range-of-motion (ROM) in referees and assistant football referees. **Methods:** Twelve referees (25.3 ± 3.3 years) and 23 assistant referees (25.1 ± 4.8 years) underwent measurements on isometric knee flexion strength and passive hip flexion ROM before and after officiating an official football match. Referees' and assistant referees' running patterns were monitored during the match using GPS technology. **Results:** In comparison to pre-match values, referees reduced their isometric knee flexion strength (-12.36% , $p = 0.046$, effect size [ES] = -0.36) in the non-dominant limb while no significant differences were reported in the dominant limb (-0.75% , $p = 0.833$, ES = -0.02). No effect of the match was found in hip flexion ROM values in dominant (-4.78% , $p = 0.102$, ES = -0.15) and non-dominant limb (5.54% , $p = 0.544$, ES = 0.19). In assistant referees, the pre-to-post-match changes in isometric knee flexion strength (dominant limb -3.10% , $p = 0.323$, ES = -0.13 ; non-dominant limb -2.18% , $p = 0.980$, ES = 0.00) and hip flexion ROM (dominant limb 1.90% , $p = -0.816$, ES = 0.13 ; non-dominant limb 3.22% , $p = 0.051$, ES = 0.23) did not reach statistical significance. **Discussion:** Officiating a match provoked a reduction of isometric knee flexion strength in the non-dominant limb of football referees while no differences were reported in assistant referees. Thus, the present data reflect hamstring muscle fatigue in football referees when officiating a match, which may lead to an increased risk of hamstring muscle injury. **References:** (1) Barbero-Alvarez J, Boulosa DA, Nakamura FY, Andrin G, Castagna C. Physical and physiological demands of field and assistant soccer referees during America's cup. *Journal of strength and conditioning research* 26(5): 1383–8, 2012. (2) Matute-Llorente A, Sánchez-Sánchez J, Castagna C, Casajús J. Injuries of a Spanish top-level sample of football referees. A retrospective study. *Apunts*

Sports Medicine 55(208): 146–52, 2020. **Mail to:** vicente.fernandez@ufv.es.

POSTER ABSTRACT PRESENTATION

SEX DIFFERENCES IN RELATIVE STRENGTH FOR WELL-TRAINED WEIGHTLIFTERS

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Introduction: Specific sex-differences in one repetition maximum have been reported in weightlifters for the back squat, overhead press, and split jerk, separately (1,2). However, the lower-body, upper-body, and weightlifting performance have not been compared in the same study in this population.

Objective: Explore the differences in relative strength of the lower-body, upper-body, and weightlifting performance for well-trained weightlifters. **Methods:** Twenty male and 13 female well-trained weightlifters voluntarily participated. The relative strength (1RM/body mass) of the back squat, overhead press, and split jerk were assessed for all participants. All tests were conducted in a randomized order and performed on separate days with more than 72 hours of rest between assessments. An analysis for independent samples was used to determine between-group differences. Furthermore, Hedges’ g effect sizes (ES) were analyzed and interpreted (3). The priori alpha level was set at $p < 0.05$. **Results:** Males had significantly greater back squat 1.9 ± 0.2 , overhead press 0.9 ± 0.1 , and split jerk 1RM performance $1.5 \pm 0.3 \text{ kg} \cdot \text{kg}^{-1}$ compared to women (1.4 ± 0.1 , 0.6 ± 0.1 and $1.1 \pm 0.1 \text{ kg} \cdot \text{kg}^{-1}$, $p < 0.001$, respectively). The greatest difference was revealed in the overhead press (ES = 2.6 [very large]), followed by back squat (ES = 1.7 [large]), and split jerk 1RM performance (ES = 1.4 [large]). **Discussion:** The overhead press exhibited the greatest difference in relative strength followed by back squat and split jerk 1RM performance between males and females well-trained weightlifters. These findings are in line with those found in the scientific literature for the lower-body (4) and upper-body strength (2), separately. However, in this study all

components (lower-body, upper-body strength, and weightlifting performance) were analyzed between males and females well-trained weightlifters. This information may help practitioners to program specific exercises and workloads according to specific sex-differences in well-trained weightlifters. **Funding:** This study was part of the F-V_FATIGUE project supported by a grant-in-aid from the Vice-Rectorate of Research and Science, at the Camilo José Cela University. **References:** (1) Storey, A, et al. *Sports medicine* 42(9): 769–790, 2012. (2) Soriano, MA, et al. *Int J Sports Sci Coach*, published ahead of print, 2021. (3) Hopkins, WG. 2017. *Sportscience*, 21. (4) Stone, MH, et al. *Med Sci Sports Exerc* 37(6): 1037–43, 2005. **Mail to:** msoriano@ucjc.edu.

POSTER ABSTRACT PRESENTATION

BONE MINERAL DENSITY IN RESISTANCE AND ENDURANCE-TRAINED PREMENOPAUSAL FEMALES

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Introduction: Resistance training and endurance training, specifically weight-bearing exercises, have beneficial effects on bone mineral density accumulation and maintenance (1,2). Conversely, reduced energy availability among female endurance athletes is common and it is linked to low bone mineral density (BMD) (2). This study aimed to compare the BMD of resistance and endurance-trained women while considering their hormonal profile [eumenorrheic vs. oral contraceptives (OC) users]. To classify the participants according to the characteristics of their usual training, Mitchell’s (3) classification has been followed: dynamic (DE) and static exercise (SE). **Methods:** Forty-eight eumenorrheic females [SE ($n = 19$): 28.6 ± 5.5 years; 61.8 ± 10.6 kg; 162.8 ± 6.6 cm; DE ($n = 29$): 35 ± 13.7 years; 58.7 ± 11.2 kg; 163.6 ± 6 cm] and 30 OC users [SE ($n = 9$): 25.3 ± 3.7 years; 61.1 ± 5.6 kg; 164 ± 3.4 cm; DE ($n = 21$): 25.4 ± 4.5 years; 56.6 ± 5.6 kg; 162.1 ± 5.6 cm] participated in this study. BMD was measured by dual-energy X-ray absorptiometry. Independent samples T-test was used to compare BMD according to the type of training (DE vs. SE). **Results:** Within OC users, a lower spine BMD in DE ($1.01 \pm 0.07 \text{ g} \cdot \text{cm}^{-2}$) was observed compared to

SE ($1.09 \pm 0.09 \text{ g} \cdot \text{cm}^{-2}$). Nevertheless, no significant differences were found in total BMD (SE: $1.19 \pm 0.07 \text{ g} \cdot \text{cm}^{-2}$ vs. DE: $1.16 \pm 0.06 \text{ g} \cdot \text{cm}^{-2}$) or hip BMD (SE: $1.21 \pm 0.11 \text{ g} \cdot \text{cm}^{-2}$ vs. DE: $1.16 \pm 0.09 \text{ g} \cdot \text{cm}^{-2}$). Likewise, no differences were seen in spine (SE: $1.09 \pm 0.09 \text{ g} \cdot \text{cm}^{-2}$ vs. DE: $1.05 \pm 0.11 \text{ g} \cdot \text{cm}^{-2}$), total (SE: $1.2 \pm 0.07 \text{ g} \cdot \text{cm}^{-2}$ vs. DE: $1.19 \pm 0.08 \text{ g} \cdot \text{cm}^{-2}$) or hip BMD (SE: $1.21 \pm 0.09 \text{ g} \cdot \text{cm}^{-2}$ vs. DE: $1.17 \pm 0.12 \text{ g} \cdot \text{cm}^{-2}$) in eumenorrhic females. **Conclusion:** OC users who practice DE show lower spine BMD in comparison to SE athletes. This could be explained by the fact that the spine is considered a relatively lower loading site during endurance running compared to the lower extremity (4). Nevertheless, we did not find any other difference in terms of BMD, suggesting that both types of training lead to similar bone health status in most of well-trained premenopausal women. The lack of differences could also be partially explained by concerns with the classification since most of the endurance participants practiced resistance training too. Futures studies with finer control of energy availability and training characteristics are needed to compare the effects of resistance and endurance exercise on BMD. **Funding:** DEP2016-75387-P. **References:** (1) McMillan L et al. *Healthcare* 5(4): 85, 2017. (2) Melin A et al. *Scand J Med Sci Sports* 25(5): 610–22, 2015. (3) Mitchell JH et al. *J Am Coll Cardiol* 45(8): 1364–7, 2005. (4) Pollock N et al. *Int J Sport Nutr Exerc Metab* 20(5): 418–26, 2010. **Mail to:** i.guisadoc@alumnos.upm.es.

POSTER ABSTRACT PRESENTATION

EFFECTS OF A HORIZONTAL PLYOMETRIC PROGRAM ON THE ASYMMETRIES OF YOUNG FOOTBALLERS

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Introduction: The integration of plyometric training programs, according to the specificity of the sport, is recommended when the objective is the reduction of asymmetries. For the implementation of this work, special attention was paid to the orientation of the force vector. The aim was to compare the effects of a horizontal and vertical plyometric component program with a horizontal plyometric component program on the asymmetries of young footballers. **Methods:** Two groups were established randomly, the first group ($n = 10$) performed a plyometric program composed of exercises with vertical and horizontal force component (V + H), the program of the second group ($n = 10$) only included exercises with vertical component

(V). The duration of the program was 6 weeks, with 2 weekly workouts of 15–20 minutes each. The unilateral jump test with countermovement (UCMJ), the unilateral triple horizontal jump (Triple) were recorded and the corresponding asymmetry indices of both tests, UCMJASY and TripleASY, were calculated respectively (1). **Results:** The training programs reduced the asymmetries of UCMJASY (DM = 18.25% 95 CI [6.38, 30.12]; $p = 0.005$) but not those of TripleASY (DM = 0.41% 95 CI [-2.08, 2.89]; $p = 0.735$). After the intervention, the V + H group obtained a lower index of asymmetry in the UCMJASY ($11.88 \pm 4.21\%$ vs. $25.25 \pm 4.44\%$, $p = 0.045$). **Discussion:** The main finding was a reduction in the asymmetries of UCMJASY after interventions with a more pronounced effect in the V + H group. This finding coincides with previous studies (3,4), which emphasize that plyometric programs can be effective in minimizing these differences. The results of this paper suggest that combining exercises with vertical and horizontal components could be more effective in reducing the asymmetries of vertical jumps with countermovement in young footballers. The combination of vertical and horizontal exercises could be an optimal strategy for planning performance improvement programs in footballers (5). **References:** (1) Gonzalo-Skok O, et al. *Eur J Sport Sci* 19(3):305–14, 2019. (2) Bishop C, et al. *Strength Cond J [Internet]* 36(6): 27–32, 2016. (3) Moran JJ, et al. *Journal of Strength and Conditioning Research*: 552–65, 2017. (4) Bishop C, et al. *J Sports Sci [Internet]* 36(10): 1135–44, 2018. (5) Yanci J, et al. *Res Sport Med* 24(4): 308–19, 2016. **Mail to:** ericalarconmatamoros@gmail.com.

POSTER ABSTRACT PRESENTATION

CAN FLOSSING USING A PNEUMATIC TOURNIQUET IMPROVE BILATERAL JUMPING ABILITY IN ELITE BASKETBALL PLAYERS?

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Introduction: Flossing is a technique that consists of applying pressure on the peri-joint structures induced by an elastic band while performing movement. Previous researches has reported

benefits on range of motion (1,2). There are few studies that analyze the effects of the application of elastic bands to induce flossing in unilateral jumping tests (2). It is unknown whether the use of pneumatic tourniquets with control manometer applied to generate flossing can influence performance in bilateral countermovement jumping tests (CMJ). **Purpose:** To record the acute effects induced by a flossing protocol with a pneumatic tourniquet placed at the intermalleolar level on bilateral jumping ability in elite basketball players. **Methods:** Twenty-four basketball players (17.16 (1.27) years; 194 (0.06) cm; 83.9 (7.55) kg; 22.23 (1.99) kg·m⁻²) from a professional club were recruited. After a familiarization phase, a pressurized cuff (continuous pressure at 180 mm Hg) was placed at the intermalleolar level for 2 minutes while the athletes performed plantar and dorsal flexion movements without load. Prior to the intervention, 5 bilateral CMJ jumps were performed on a force platform and repeated 5 minutes post flossing intervention. **Results:** The intervention showed no significant difference ($p > 0.05$) in jumping performance in mean PRE 32.45 (4.66) cm/1011.62 (91.69) w vs. POST 33.07 (4.95) cm/1022.11 (97.96) w and in best record PRE 33.76 (4.66) cm/1032.62 (94.01) w vs. POST 34.24 (5.19) cm/1040.21 (97.18) w in the CMJ jump. **Conclusions:** The application of intermalleolar flossing using pneumatic tourniquet in elite basketball players did not generate any significant change in jumping ability. These findings suggest that the use of the pneumatic tourniquet applied to the ankle joint could be used in basketball players without affecting their jumping ability and could enjoy other previously demonstrated benefits such as increased range of motion (2). **Keywords:** bilateral jumping, flossing, power. **References:** (1) Stevenson PJ, Stevenson RK, Duarte KW. Acute Effects of The Voodoo Flossing Band on Ankle Range of Motion. *Journal of Medical Biomedical and Applied Sciences* 7(6): 244–53, 2019. (2) Pisz A, Kralova K, Blazek D, Golas A, Stastny P. Meta-analyses of the effect of flossing on ankle range of motion and power jump performance. *Baltic Journal of Health and Physical Activity* 12(2): 19–26, 2020. **Mail to:** darioRodrigom@gmail.com.

POSTER ABSTRACT PRESENTATION

ONE-YEAR EVOLUTION OF FORCE-VELOCITY PROFILE IN ELITE FEMALE PLAYERS

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Introduction: Force-velocity profiling (FVP) has gained popularity in recent years in order to identify an athlete's force-power-velocity characteristics (1). Nevertheless, since a long time ago, Bosco's index has been used with a similar purpose (2), having recently shown a relationship with different specific actions in team sports such as field hockey (3). The aim of the study was to analyse the evolution of the FVP during one year of training in elite female field hockey players based on Bosco's index. **Methods:** Twelve elite female field hockey players participated in the study carried out during the 2018–2019 and 2019–20 20 seasons. All the players performed specific strength training session (25–40 minutes) every week, which consisted of 4 main exercises (squat, squat jump, single-leg deadlift, and clean) in a maximal strength or maximal power regimen, depending on the season's periods. In addition, the jumping ability of the players was periodically assessed using a countermovement jump (CMJ) and a CMJ50 (CMJ with external loads of 50% bodyweight) tests. The FVP was calculated with Bosco's index (FVP50 = CMJ50/CMJ × 100) (2). Participants gave their informed written consent to participate in the study, which was carried out in accordance with the Declaration of Helsinki. **Results:** There were significant improvements ($p < 0.05$) between the 2018–2019 and 2019–2020 seasons in CMJ (30.1 ± 3.7 vs. 31.9 ± 4.0 cm), CMJ50 (15.8 ± 3.1 vs. 18.2 ± 2.7 cm) and FVP50 (52.2 ± 7.5 vs. 57.2 ± 4.9 cm). However, the percentage of improvement was greater ($p < 0.05$) in CMJ50 (17.7%) than in CMJ (6.3%) and FV50 (11.2%). **Discussion:** The implementation of a weekly strength training session was sufficient to improve the values in the 3 variables that were tested (CMJ, CMJ50 and FV50). Moreover, the greatest impact shown in the maximal strength test (CMJ50) would be critical to improve repeated sprint ability (RSA) related variables like maximal speed and fatigue index (3). Therefore, this strength training program can be an adequate alternative to perform in many clubs to achieve a high impact on their physical performance. In addition, the FVP test was shown to be a simple and practical method to improve performance. **References:** (1) Morin, J., and Samozino, P. *International Journal of Sports Physiology and Performance* 11: 267–272, 2016. <https://doi.org/10.1123/ijsp.2015-0638>. (2) Vélez, M. (1992) EL entrenamiento de fuerza para la mejora del salto. APUNTS, XXIX: 139–156. (3) González-Frutos et al. (2018) Relationship between force-velocity profile with repeated sprint ability and change of direction abilities. XI International Symposium in Strength Training, 52–54. **Mail to:** p.gfrutos.prof@ufv.es.

ORAL ABSTRACT PRESENTATION

EFFECT OF MODIFIED FEEDBACK ON POWER OUTPUT IN THE BENCH PRESS**GARCÍA-AGUILAR F., OLIVER-LÓPEZ A., ASENCIO P., AND SABIDO R.***Universidad Miguel Hernández, Elche, Alicante, Spain*

Introduction: External feedback about physical movements can modify performance in those actions. Several authors have reported that human motor performance is greater when athletes receive external feedback about execution. Feedback or knowledge of results can be qualitative or quantitative. When feedback is quantitative, coaches can employ a neutral or modified feedback. Modified feedback is a variation where the performance results could be increased (IN) or decreased (DE). IN feedback has been shown to produce better results than no feedback or DE feedback during isometric force evaluations (2). Since there is little information on the effect of feedback type on ballistic strength exercises, the aim of this study was to analyse the effect of different types of feedback on power production in the bench press exercise. **Methods:** For this purpose, 14 men with experience in resistance training were recruited to perform 2 sessions separated by at least 48 hours. The first session was a familiarization session and their bench press maximum repetitions (RM) were calculated. During the second session, participants performed 6 sets of 6 repetitions at 50% RM, with a rest between repetitions of 15 seconds and between sets of 3 minutes. During the rest between repetitions, a neutral (repetition result without change), IN feedback (+5% of repetition result) or DE (-5% of repetition result) was administered in random order between sets in the training session. **Results:** An analysis of variance (ANOVA) was employed to compare power values of repetitions after the different feedback administered. No significant differences were found between the different types of feedback. **Discussion:** The results obtained do not coincide with those reported by other authors (2,3). We believe this discordance in the results may be due to task constraints (to execute as fast as possible) or to participant constraints (effect of feedback vary between participants). Although from previous research it seems that feedback always has a positive effect, it is not clear if the use of IN vs. DE feedback increases performance more. **References:** (1) Vanderka M, Bezák A, Longová K, Krčmár M, Walker S. Use of Visual Feedback During Jump-Squat Training Aids Improvement in Sport-Specific Tests in Athletes. *J strength Cond Res* 34(8): 2250–7, 2020.(2) Halperin I, Ramsay E, Philpott B, Obolski U, Behm DG. The effects of positive and negative verbal feedback on repeated force production. *Physiol Behav [Internet]* 225: 113086, 2020. Available from:

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POSTER ABSTRACT PRESENTATION

EFFECT OF ACUTE CREATINE MONOHYDRATE SUPPLEMENTATION FOR PERFORMANCE ENHANCEMENT IN A FEMALE HEPTATHLETE-CASE STUDY**SERRANO A., AND GARRIDO G.***Facultad de Ciencias de la Actividad Física y el Deporte-INEF, Universidad Politécnica de Madrid, Madrid, Spain*

Introduction: Creatine supplementation is known for its ergogenic capacity; that is why numerous athletes use it to maximize their performances and achieve an optimal body composition. This study analyzes the effect of acute supplementation during 5 days with creatine monohydrate (9g/d) in a heptathlete. **Methods:** A high-performance female heptathlete (21 years; weight: 60.5 kg, and height: 174 cm) was assessed for diet composition, energy expenditure, body composition, and strength performance. Every food item intake was weighed for processing data over 5 days using a food composition software, Dial Alce Ingeniería, to determine the 3 macronutrients and several micronutrients. The athlete wore a SenseWear accelerometer on her right arm during the same five-day period to estimate energy expenditure. On 2 occasions (before and after creatine supplementation), anthropometric and strength measures were taken. Anthropometric data were measured following the International Society for the Advancement of Kinanthropometry (ISAK) protocol. Two strength tests were completed: repeated sprint availability (RSA) and maximal strength (1RM) for half squat and bench press. **Results:** Energy intake (2289 ± 198 Kcal) and energy expenditure (2358 ± 317 Kcal) were similar. Energy distribution shows that 50% of energy comes from carbohydrates (CHO); 20% from proteins (P), and 30% from fats (F). Specifically the total daily macronutrients intake in absolute value and referred to weight were: CHO ($258 \text{ g} \cdot \text{d}^{-1}$; $4.5 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-2}$); P ($118 \text{ g} \cdot \text{d}^{-1}$; $1.9 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-2}$), and F (77.7 g ; $1.3 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-2}$); we found deficient vitamin D ($2.3 \mu\text{g} \cdot \text{d}^{-1}$) and calcium ($958 \text{ mg} \cdot \text{d}^{-1}$) intakes. More than 50% of total P intake came from animal foods, and more than 90% of the total CHO came from plant foods. Furthermore, regarding body composition, the outcome shows an increase in muscle mass from 38.9 to 39.4%. The 1RM tests show an 11% increase in strength for both exercises (half squat and bench press) after creatine monohydrate supplementation, although no significant changes were

observed regarding the sprint protocol (RSA). **Discussion:** This study shows the relevance of individualization regarding nutritional and supplementation strategies. Although the diet composition was adequate in energy and macronutrients intake, micronutrient intake was suboptimal for vitamin D and calcium, suggesting that a possible supplementation combined with creatine could be considered after a complete diet analysis in female heptathletes. **References:** Butts J, Jacobs B, Silvis M. Creatine Use in Sports. *Sports Health* 10(1): 31–33, 2018. **Mail to:** ainhoacole@gmail.com.

POSTER ABSTRACT PRESENTATION

PRELIMINAR VALIDATION OF A COMPUTER VISION BASED APP TO MEASURE MOVEMENT VELOCITY ON BACK SQUAT

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Introduction: Monitoring movement velocity is important to determine the real intensity in resistance exercise and allows practitioners to control performance and fatigue during and between sessions, moreover to estimate 1RM. To achieve it, different expensive commercially available devices exist, like linear transducers, camera-based optoelectronic systems, or inertial measurement units, but they could be difficult to access for many athletes (2). The aim of this study was to show results of a preliminary validation of Spleeft, a smartphone app that allows practitioners to measure movement velocity and in real-time, which relies on a scientifically-validated convolutional neural network (machine learning based) for human pose estimation (3). **Methods:** The subjects performed 100 repetitions of back squat exercise with loads between 50 and 95% of 1RM, which were recorded at the same time with 2 mid-range Android smartphones (Xiaomi Redmi Note 6 Pro and Xiaomi Mi A3) running Spleeft and with an Apple iPhone 7 recording slow-motion video with My Lift to measure barbell velocity. The results of My Lift were used as gold standard, as it was previously validated against linear transducer (2). **Results:** Comparison between Spleeft and My Lift revealed an intra-class correlation coefficient (ICC) of 0.997, both for Xiaomi Redmi Note 6 Pro (CI = 0.962–0.986; $p < 0.001$). Inter-devices comparison showed an ICC of 0.976 (CI = 0.963–0.984; $p > 0.001$). **Discussion:** Spleeft shows valid measures of velocity using My Lift as gold-standard, as well as inter-device reliability when measures are done with 2 different devices. This results suggest that, in contrast to other devices (2), Spleeft is an affordable solution that allows to measure movement velocity

in real-time with similar validity that other technologies using mid-range smartphones. We hypothesize that it can be reliable also for 1RM estimation. Furthermore, it means an innovation in the use of computer vision applied to sport because it has been mainly used in individual sports to detect movements and skills, but also a few times to collect velocity data from pose detection (4). The main limitation of the study is that we used a gold standard scientifically-validated app instead of a linear transducer. **References:** (1) González-Badillo JJ, Sánchez-Medina L. *Int J Sports Med* 31(5): 347–52, 2010. (2) Pérez-Castilla A, et al. *J Strength Cond Res* 33(5): 1258–65, 2019. (3) Bazarevsky V, et al. CVPR Workshop on Computer Vision for Augmented and Virtual Reality, 2020. (4) Thomas G, et al. *Comput Vis Image Underst* 159: 3–18, 2017. **Mail to:** ivandelucas2000@gmail.com.

POSTER ABSTRACT PRESENTATION

MUSCULOSKELETAL REGENERATION AFTER EXERCISE-INDUCED DAMAGE: THE ROLE OF GLUCOSE-6-PHOSPHATE DEHYDROGENASE AND PHYSICAL PRECONDITIONING

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Introduction: Physical exercise induces mild musculoskeletal injuries that need rapid and efficient repair in order to preserve muscle homeostasis and glucose-6-phosphate dehydrogenase plays an important role in the regeneration of skeletal muscle. The objective was to study the role of glucose-6-phosphate dehydrogenase and physical preconditioning in musculoskeletal regeneration. **Methods:** To monitor myofiber response to localized damage, we studied musculoskeletal samples obtained from both young C57Bl/6J mice ($n = 20$) and humans ($n = 15$) after performing one bout of eccentric exercise. Myofibers were isolated 5, 24, and 48 hours after exercise and stained for Filamin C and Hsp27, 2 markers of sarcomere damage (2,3). To better characterize myofiber repair, we examined the effects of 5 days of eccentric training in young C57Bl/6J mice ($n = 40$). After testing for normality, a one-way analysis of variance (ANOVA) test was conducted to compare means between groups. Data are expressed as mean (standard deviation). A value of $p < 0.05$ was considered statistically

significant. **Results:** Myofibers isolated at 5 and 24 hours post-exercise displayed Filamin C-enriched regions (termed scars hereafter), whereas scarring was absent in unexercised myofibers or reduced in those obtained 48 hours post-exercise. Filamin C scars also occurred in human muscle fibers after a single eccentric exercise session, indicating that this physiological mechanism is conserved across species. After an acute bout of exercise, we observed the presence of Filamin C protein and the increased expression of FlnC and Hspb1 mRNA transcripts as early as 30 minutes after eccentric exercise. Compared to untrained mice, in mice trained on eccentric exercise for 5 days, the repair damage response to acute exercise was clearly diminished. Finally, this repeated bout effect induced a robust increase both in the mRNA levels (2.33 [0.65] vs. rest mice 1.02 [0.23] fold change, $p < 0.05$) and the glucose-6-phosphate dehydrogenase activity (1.41 [0.78] vs. rest mice 0.46 [0.16] $\text{nmol} \cdot \text{min}^{-1} \times \text{mg protein}$, $p < 0.05$) in skeletal muscle in trained mice. **Discussion:** In conclusion, exercise-induced increase in the endogenous antioxidant protection may generate a cellular hyper-defensive state, one of the molecular bases of the reported beneficial effects of exercise, as well as physical preconditioning attenuates the myofiber repair response. **Funding:** This work was supported by Instituto de Salud Carlos III CB16/10/00435 (CIBERFES), (PID2019-110906RB-I00/AEI/10.13039/501100011033) from the Spanish Ministry of Innovation and Science; 109_RE-SIFIT from Fundación General CSIC. **References:** (1) Wagner KR, et al. *Biochem J* 1978;170(1): 17–22, 1978. (2) Paulsen G, et al. *Am J Physiol-Regul Integr Comp Physiol* 293(2): R844–53, 2007. (3) Collier MP, et al. *Sci Adv* 5(5): eaav8421, 2019. **Mail to:** esther.garcia-dominguez@uv.es.

POSTER ABSTRACT PRESENTATION

THE ROLE OF POWER OUTPUT IN METABOLIC INFLEXIBILITY IN THE OLDER FEMALE ADULTS

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Introduction: Power is a key marker of physical function in older adults, with a demonstrated inverse association between this indicator and age. In turn, ageing is characterized by marked mitochondrial dysfunction (2), thus impairing metabolic flexibility (MF) or the ability to switch energy substrates, especially when it comes to the

lipolytic pathway (3). The impact of ageing on both, muscular power and MF, seems clear, but little is known regarding their relationship while aging, and the role of this relationship in elderly performance. Current literature suggests that well-trained subjects who present greater physical fitness and power, also present greater ability to oxidize fat (3), with both factors attenuated by ageing (3). Therefore, this study aims to observe the role of power (i.e., neuromuscular capacity) in the alternation of substrates during exercise (assessed at the point of maximal fat oxidation), in a population of elderly females. **Methods:** Sixteen active women (68.61 \pm 7.30 years) completed a submaximal incremental cycling protocol (10W/3/15''), with gas analysis by indirect calorimetry (Cosmed K4b2, Rome, Italy), and pre-posttest lacticaemia (3–5 minutes). Power was registered with Saris H3 roller (Madison). The calculation of MF was performed by applying Frayn's equations (4), with determination of the maximum fat oxidation point (MFO; $\text{mg} \cdot \text{min}^{-1} \cdot \text{kg}^{-2}$ fat free mass). **Results:** Regarding age, power showed a large negative association ($r = -0.85$, $p < 0.05$, $R^2 = 0.72$), while MFO presented a medium negative association ($r = -0.54$, $p = 0.04$, $R^2 = 0.29$). A positive significant and medium correlation was found between power and MFO ($r = 0.71$, $p = 0.04$, $R^2 = 0.50$). In addition, this association remained positive but slightly lower with age as a covariate ($r = 0.56$, $p = 0.04$). **Discussion:** The results point to a determinant effect of age on both power and the point of maximum fat oxidation, with higher impact on the neuromuscular indicator. Power confirms to be moderately related to fat oxidation, but this comes to a lower extent when age is considered. Future studies may confirm this role of power in the preservation of MF while aging, reinforcing the need of strength and power training in this population. **Funding:** This study was funded by GESMED (Gestió Socio Sanitaria al Mediterrani). **References:** (1) Reid, KF, et al. *Exerc Sport Sci Rev* 40(1), 4–12, 2012. (2) Monferrer-Marín, J, et al., *The Physiological Society*, 2021. (3) Frandsen, J. et al., *Eur J Sport Sci* 21(1): 69–76, 2021. (4) Frayn, K. N. *Journal of Applied Physiology* 55(2): 628–634, 1983. **Mail to:** jordimonferrermarin@gmail.com.

POSTER ABSTRACT PRESENTATION

A SELF-ADMINISTERED WEIGHT LOSS PROGRAM, TRYING TO MAINTAIN STRENGTH LEVELS: A CASE STUDY

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Introduction: Overweight and obesity are diseases defined as excessive fat accumulation that is detrimental to health, and is associated with different metabolic, physical, and psychological problems. We know that maintaining high levels of strength is

related to an improvement in the physical qualities and a higher quality of life (2). In addition, strength training is the basis for maintaining the muscle mass created, so we can assume that, after undergoing a weight loss program, it is the best way to avoid a subsequent weight recovery. The purpose of this intervention was to improve body composition, reducing fat-mass levels and maintaining strength levels by applying a weight loss-oriented training, physical activity, and nutrition program.

Methods: A weight loss program was carried out for 16 weeks in a 26-year-old male (1.86 meters and 109.1 kg of body mass [BMI = 31–54]) subject. The participant performed a resistance training program combined with physical activity and a nutritional intervention (around 600 Kcal calorie restriction). To study body composition, tests were performed based on dual-energy X-ray absorptiometry (DXA) (Lunar Prodigy Primo) and anthropometry measurements. To evaluate strength levels, 3RM test was performed in the back squat, bench press, and deadlift exercises, and a maximal repetitions test in the pull-up exercise. **Results:** We observed a reduction in body mass of 14.8 kg through DXA

and 15.9 kg through anthropometry, being 14.72 kg (99.5% of weight loss) fat-mass. There have been reductions in strength levels of 2.83 and 2.86% in the squat and deadlift exercises, respectively. There have been improvements of 2.93 and 3.66% in the exercises of bench press and pull-ups, respectively.

Discussion: As long as it can get adapted to the characteristics and preferences of the subject, strength training along with increasing physical activity and a nutritional control are a real alternative in a weight loss program. It is possible to achieve a weight loss goal without compromising strength levels. From a practical point of view, this case would indicate the possibility of weight loss intervention while maintaining muscle mass, which cannot be achieved by calorie restriction alone. **References:** (1) Rodríguez Martínez G, et al. Uso del índice de masa corporal para valorar la obesidad en niños y adolescentes. Vol. 4, REO: 84–8, 2006. (2) Hart PD. Grip Strength and Health-Related Quality of Life in U.S. Adult Males. *J Lifestyle Med* 31;9(2): 102–10, 2019. **Mail to:** hector.ortizdepinedo@alumnos.upm.es.