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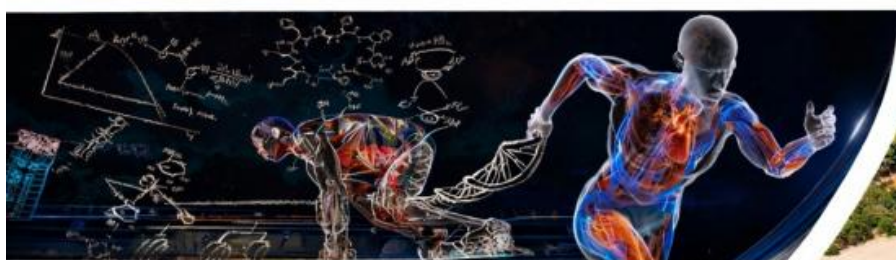


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Book of Abstracts

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Abstract 1

ANALYSIS OF FORCE–TIME CHARACTERISTICS AND INTER-LIMB ASYMMETRY IN CMJ AND SJ

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Department of Mechanical, Chemical and Materials Engineering ~ Cagliari ~ Italy

The countermovement jump (CMJ) and squat jump (SJ) are widely used to assess lower-limb neuromuscular performance. While jump height is the most common outcome, force–time metrics derived from ground reaction force (GRF), such as peak force and impulse, may provide a more comprehensive characterization of neuromuscular strategies and inter-limb asymmetry, which has been increasingly investigated due to its potential links with performance and injury risk [1]. Due to its dependence on the specific phase of the movement, asymmetry may manifest differently across the task [2], thus a more comprehensive analysis, which considers peak force, impulse, and inter-limb asymmetry during the propulsive and landing phases is desirable. This study aims to investigate such aspects in a cohort of soccer and volleyball athletes who compete at national level.

A total of 123 elite athletes from professional teams performed three CMJs and three SJs on a dual force plate system. GRF signals were used to extract peak force and impulse during the propulsive and landing phases, with phase identification based on GRF thresholds. Inter-limb asymmetry was quantified using an asymmetry index (AI):

$$AI (\%) = 100 \times |right - left| / (right + left)$$

applied to both peak force and impulse variables. Values of AI exceeding a cut-off of 10% [3] were considered indicative of non-physiological asymmetry. Statistical analyses compared jump conditions and assessed inter-limb differences, correlations, and asymmetry patterns across phases.

Asymmetry indices confirmed a phase-dependent pattern. In CMJ, associations were observed within phases but not across phases. Similar results were observed in SJ, with weak or inconsistent relationships between phases.

The propulsive phase was predominantly symmetric (CMJ: 94.31%; SJ: 88.62%). In contrast, landing showed reduced symmetry (CMJ: 45.53%; SJ: 40.65%) and greater intra-subject variability in asymmetry patterns across trials. For landing impulse, symmetry further decreased to 17.07% in both tasks, with most athletes exhibiting either consistent asymmetry (CMJ: 48.78%; SJ: 52.85%) or changes in asymmetry direction between limbs (CMJ: 34.15%; SJ: 30.08%).

No significant inter-limb differences were observed for peak force or impulse in either CMJ or SJ. However, inter-limb relationships showed a phase-dependent pattern. In CMJ, peak force exhibited high inter-limb consistency during propulsion ($r=0.94$) and lower consistency during landing ($r=0.69$). Impulse showed a progressive reduction in consistency from concentric ($r=0.50$) to eccentric ($r=0.24$) phases, with no association during landing. A similar

pattern emerged in SJ, with high consistency for propulsive peak force ($r=0.95$), moderate for landing ($r=0.69$), weak for concentric impulse ($r=0.29$), and no association was found for landing impulse.

Our findings suggest that, although inter-limb outputs may appear symmetrical at the group level, coordination between limbs is strongly phase-dependent. Force production phases are characterized by high inter-limb consistency across trials and stable symmetry patterns, whereas landing shows reduced consistency, greater variability, and frequent changes in asymmetry direction within the same individual.

These results indicate that asymmetry is not a stable trait, but rather a dynamic and phase-specific phenomenon. The lack of consistency between propulsion and landing suggests that distinct neuromuscular strategies underlie force generation and impact absorption. This pattern was consistent across both CMJ and SJ, indicating that the increased variability observed during landing is not task-specific but intrinsic to the impact phase. The greater variability during landing likely reflects the increased demands for rapid stabilization and load redistribution.

From an applied perspective, these findings highlight the limitations of global asymmetry metrics. A phase-specific approach integrating peak force, impulse, and asymmetry behavior may provide more meaningful insights for performance monitoring and injury risk assessment in elite athletes.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 2

EFFECTS OF RAMADAN INTERMITTENT FASTING ON POSTURAL CONTROL, DYNAMIC STABILITY, AND NEUROMUSCULAR PERFORMANCE

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The effects of Ramadan intermittent fasting (RIF) on athletic performance have been widely investigated, with evidence suggesting that trained individuals generally preserve aerobic and anaerobic capacity despite changes in hydration, sleep, and meal timing [1]. However, most studies have focused on metabolic and performance outcomes, with less attention to biomechanical and neuromuscular domains, including postural control, dynamic stability, and kinematic adaptations under fatigue. These aspects are particularly relevant in sports characterized by intermittent activity patterns, involving alternating phases of low-intensity locomotion and higher-intensity efforts, which place substantial demands on neuromuscular control.

A single-case design was adopted, with two identical sessions before (PRE) and after (POST) Ramadan. Static balance was assessed via postural sway in bipedal (eyes open/closed) and unipedal conditions. COP metrics (mediolateral and anteroposterior displacement, sway area, path length, mean velocity) quantified the effectiveness of postural control.

Dynamic stability was evaluated for a submaximal jump task consisting of a bipedal take-off followed by unipedal landing. Time to stabilization (TTS) was calculated based on the vertical component of the ground reaction force as the time required for the signal to return within a predefined stability threshold, reflecting the ability to quickly regain postural balance after landing.

Lower-limb neuromuscular performance was assessed using countermovement jump (CMJ) and squat jump (SJ) on a dual force platform, with jump height from flight time and force–time variables analyzed.

Endurance performance was assessed via a six-minute walking test (6MWT), during which spatiotemporal parameters of gait (step/stride length, cadence, stance/swing, double support, velocity, distance) were collected using wearable inertial sensors. Tests were conducted under standardized conditions and at the same time of day.

Static postural control was the only domain showing a deterioration in the POST condition. Indeed, concurrent increases in COP displacement, sway area, path length, and velocity were observed across all conditions, with more marked changes in absence of visual input. Unipedal stance revealed a side-dependent response, with greater instability in the non-dominant limb.

Dynamic stability improved, with a reduction in TTS in both limbs (dominant: 1.31 to 0.63 s; non-dominant: 1.55 to 1.28 s).

Neuromuscular performance also improved, with increases in both SJ and CMJ height. CMJ

showed the largest change (0.29 to 0.34 m, +17%), while SJ increased from 0.29 to 0.31 m (+7%).

Endurance performance improved following Ramadan, with total distance covered increasing from 670 to 710 m. Average walking velocity increased from 6.7 to 7.1 km/h, primarily due to an increase in stride length (168 to 179 cm), while cadence and temporal parameters remained mostly unchanged.

The main finding of this study is a clear dissociation between performance- and control-oriented domains following Ramadan. While endurance, neuromuscular output, and dynamic stability improved, static postural control deteriorated, suggesting a task-specific reorganization rather than a uniform effect of fasting.

Improved jump performance and reduced time to stabilization indicate enhanced neuromuscular output and coordination during dynamic tasks. These adaptations may reflect compensatory mechanisms, such as increased central drive or more efficient motor unit recruitment. Conversely, the decline in static postural control suggests impaired fine postural regulation. Greater instability in eyes-closed conditions indicates increased reliance on visual input and possible alterations in sensory integration, particularly at the proprioceptive and/or vestibular level. This supports the idea that static and dynamic postural control rely on partly distinct neural mechanisms, which may be differently affected by factors such as sleep disruption, dehydration, or central fatigue [2].

From an applied perspective, performance capacity may be preserved or even improved following Ramadan [1]. However, reduced static postural control may represent a subtle risk factor in tasks requiring precise balance or under fatigue. Overall, Ramadan fasting appears to induce a functional reorganization of motor control, with improved dynamic performance alongside reduced static stability. These findings highlight the need for a multidimensional approach to performance evaluation.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 3

CONTACTLESS DUAL-MMWAVE RADAR SIMULATION FOR ATHLETE GAIT PROFILING AND RETURN-TO-PLAY SCREENING

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Background: Sports medicine needs fast, objective and non-invasive tools to quantify gait adaptations related to fatigue, asymmetry, footwear/orthotic perturbations and return-to-play. Radar micro-Doppler analysis has been used to extract gait parameters and identify subtle athlete movement conditions [1-3].

Objective: To develop and test a MATLAB simulation of a 10 m dual-mmWave radar gait protocol for athlete-oriented biomechanical screening.

Methods: A self-contained MATLAB model simulated two 77 GHz FMCW radars positioned at the ends of a 10 m corridor. Four athlete profiles were generated: baseline gait, fatigue, unilateral protective loading/return-to-play concern, and shoes with a 2 cm heel-lift surrogate. The virtual cohort included 20 athletes, 3 trials per condition (240 simulated trials). Signals included direct path, clutter, multipath and additive noise (SNR 14 dB). Processing used Hamming FIR clutter suppression, short-time Fourier transform micro-Doppler maps, a 97.5th percentile lower-limb velocity envelope and distance-based dual-radar fusion. Extracted variables included step time, cadence, walking speed, step-time variability, temporal symmetry, peak lower-limb micro-Doppler velocity and a fatigue-related index. Radar signatures were classified with an mD-SPA-inspired PCA+LDA pipeline using an 80/20 train-test split.

Results: Simulated radar processing generated continuous micro-Doppler signatures over the complete outward and return 10 m task. In the test set (48 trials), the PCA+LDA classifier correctly identified 44/48 trials, corresponding to 91.7% accuracy. Fatigue and unilateral loading were classified without errors (12/12 each), while baseline and heel-lift conditions were each confused in 2/12 trials, mainly with each other. Mean radar-derived step time was 0.415 ± 0.017 s versus 0.503 ± 0.030 s in ground truth, corresponding to a mean absolute percentage error of 17.2%; event-level step-time error was $22.7 \pm 3.2\%$. Radar-derived temporal symmetry was 0.937 ± 0.046 versus 0.963 ± 0.038 in ground truth. Walking speed was recovered with negligible numerical error (<0.001 m/s) because the simulated range trajectory was explicitly available. Compared with single-radar processing, dual-radar fusion produced a modest mean step-time error reduction of 1.4%, with larger benefits in fatigue (2.4%) and heel-lift (2.8%) simulations.

Conclusion: This simulation suggests that dual mmWave radar micro-Doppler analysis can provide a contactless, privacy-preserving framework for athlete gait profiling, especially for classifying fatigue, unilateral protective loading and footwear/orthotic perturbations during a 10 m test. Current step-event timing accuracy remains moderate and the model should be validated with real athletes, force platforms or motion capture before clinical use. The

approach may support future sport-science screening, rehabilitation monitoring and return-to-play decision making.

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Abstract 4

GENOME WIDE ASSOCIATION STUDY OF PERFORMANCE RELATED TRAITS IN ELITE LITHUANIAN ATHLETES

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Vilnius University Faculty of Medicine ~ Vilnius ~ Lithuania

Advances in human genomics have identified hundreds of performance related genetic variants, yet substantial gaps remain in understanding how specific variants influence athletic phenotypes. This study aimed to conduct a genome wide association study (GWAS) to identify whole genome variation associated with key performance traits in elite Lithuanian athletes.

A total of 96 elite Lithuanian athletes (55 males, 41 females; Olympic and international championship medalists) representing sprint/power and endurance disciplines were assessed. Phenotyping included anthropometry, body composition and functional performance tests (dynamometry, vertical jump, stair climb, maximal oxygen consumption (VO₂max)). Genome-wide genotyping was performed using the Illumina Infinium Global Screening Array 24 v3.0 kit. After quality control, 167,687 single nucleotide polymorphisms (SNPs) were analyzed. Statistical analyses were conducted using freely available software tools GenomeStudio, PLINK v2.0, and RStudio v4.4.2. Associations were considered statistically significant at $p < 2.9 \times 10^{-6}$ (Bonferroni corrected), while associations with $p < 5 \times 10^{-5}$ were considered suggestive.

The main findings revealed that higher aerobic capacity (VO₂max) was significantly associated with intronic alleles rs72663969 G, rs1505413 A, and rs13410678 G, indicating a potential regulatory influence of non-coding regions on endurance traits. Greater maximal explosive muscle power (vertical jump test) was associated with intronic alleles rs4755280 C and rs428073 G. Higher anaerobic alactic power (stair climb test) was linked to an exonic missense variant rs136899 A in TAOK3, a gene involved in MAPK (p38, JNK) signaling pathways regulating skeletal muscle contraction and adaptation to high-intensity exercise, indicating a potential direct functional effect on protein structure and anaerobic performance. Additionally, athletes carrying the AA genotype of the rs13027870 SNP in the ACOXL gene exhibited higher fat mass values. ACOXL is involved in fatty acid metabolism, particularly in peroxisomal β -oxidation pathways, suggesting a potential role in lipid utilization and body composition regulation.

The findings highlight a predominant contribution of intronic regulatory variation, alongside a distinct missense signal, to elite athletic performance. These results provide a foundation for future replication studies and polygenic modeling.

Award: Yes as Young Researcher (under 35 years)

Abstract 5 (Keynote Lecture)

TWO DECADES OF RESEARCH ON GENETIC RISK FACTORS FOR ACL RUPTURE: HAVE WE MADE SIGNIFICANT PROGRESS?

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Family history is an important risk factor for anterior cruciate ligament (ACL) rupture, with individuals who have affected relatives showing an estimated two-fold increased risk. Although genetics contributes substantially to ACL rupture susceptibility, the condition is unlikely to be caused by a single gene, as many anatomical and neuromuscular risk factors are themselves multifactorial and genetically influenced. Over the past two decades, research has mainly focused on candidate-gene studies investigating variants in genes involved in ligament structure and biology, such as collagens, proteoglycans, cytokines, and matrix metalloproteinases. However, findings have often been inconsistent because studies were small, population-specific, and examined only a limited number of variants. Evidence increasingly suggests that ACL rupture risk is polygenic, involving complex gene-gene interactions that differ across populations. Despite the human genome containing around 20 000 protein-coding genes, fewer than 0.2% have been investigated in ACL research. Emerging evidence also highlights potential roles for non-coding RNAs and epigenetic mechanisms in ligament biology and injury risk. Genome-wide association studies and next-generation sequencing offer broader approaches for identifying genetic contributors, but require large, clinically well-defined cohorts and independent replication. Overall, larger and more diverse studies are needed to clarify the genetic basis of ACL rupture risk.

Award: No

Abstract 6

INFLUENCE OF ACE AND ACTN3 GENETIC VARIANTS ON ENDURANCE, RESISTANCE AND CONCURRENT TRAINING OUTCOMES IN A FEMALE GENERAL POPULATION SAMPLE: INTEGRATION WITH METABOLOMICS DATA

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Background. Individual variability in training response is partly explained by genetic factors. ACE I/D (rs4646994) [9], is associated with cardiovascular adaptation, aerobic performance and muscle phenotypes [1,2]. ACTN3 R577X (rs1815739) influences α -actinin-3 expression, muscle fibre traits and power/sprint phenotypes [3,4,10]. ACTN3 genotype has also been reported to affect strength adaptations in women [5], and both markers have been proposed for genotype-informed training prescription [6]. Evidence in active, non-elite, adult females remains limited. This genetic sub-analysis is embedded within the FEMIS project, integrating performance testing and metabolomics profiling.

Aim. To determine whether ACE I/D and ACTN3 R577X polymorphisms modulate performance and physiological outcomes in healthy adult females across endurance, resistance and concurrent training phases, and to explore future concordance with metabolomics-derived biomarkers.

Methods. Of 12 enrolled females (age 36.6 ± 4.0 y; BMI 27.3 ± 3.8 kg/m²), 8 completed per-protocol participation; N=2 withdrew due to pregnancy and N=1 active control was analysed separately (different training modality). DNA was extracted from buccal swabs and genotyped for ACE I/D and ACTN3 R577X by PCR-RFLP. Participants completed 12 weeks of sequential training phases: (i) endurance, (ii) resistance, and (iii) concurrent training, ongoing at submission; frequency was 3 sessions/week. Outcomes included session RPE and heart rate during endurance; Back Squat 5RM and Farmer Carry 2KB 2-minute max distance during resistance. Farmer Carry was selected as a field grip-endurance test related to strength phenotypes reported in the literature [7,8]. Associations were tested by Spearman rank correlation using additive genotype models (ACTN3: RR=0, RX=1, XX=2; ACE: II=0, ID=1, DD=2). Alpha=0.05.

Results. Genotype distribution in the intervention sample was ACE II=1, ID=4, DD=5 and ACTN3 RR=1, RX=7, XX=2. No ACE-related association was detected (all $p > 0.55$), likely reflecting the unfavourable genotype distribution and high DD frequency. For Back Squat 5RM, complete pre-post data were available in five participants. A negative correlation emerged between ACTN3 additive score and percentage strength gain ($\rho = -0.894$, $p = 0.041$): RR +94.4%, RX +54.6%, XX +40.0%. Farmer Carry showed convergent directionality: the only XX participant had a negative delta (-30.0%), whereas R-carriers improved by +61.5% on average (N=7; $\rho = -0.668$, $p = 0.101$). No ACE-ACTN3 interaction could be reliably tested. Metabolomics data are being integrated to assess genotype-stratified metabolic signatures.

Conclusion. In this female general population pilot sample, ACTN3 R577X showed a directional association with resistance training adaptation across two functional tests, while ACE I/D produced no detectable association. The Back Squat/Farmer Carry pattern supports the biological plausibility of an ACTN3-related response beyond elite speed-power contexts [10]. Larger stratified recruitment is needed, with metabolomics integration to support personalised training prescription in non-athletic women.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 7

PRELIMINARY GENE–ENVIRONMENT SIGNALS IN PRECISION EXERCISE FOR FIBROMYALGIA: THE ROLE OF HTR2A RS6313 IN THE FIBROGENHIIT PROJECT

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Background. Individual responses to exercise interventions in fibromyalgia are highly variable and may be influenced by both genetic and environmental factors [1-4]. The serotonergic system has been implicated in pain perception, fatigue, mood regulation, and exercise adaptation [2-3].

Objective. This study explored potential gene–environment interactions between HTR2A rs6313 genotype and exercise setting (indoor versus outdoor HIIT) on clinical outcomes in women with fibromyalgia.

Methods. This exploratory secondary analysis included 43 participants with fibromyalgia from the intervention arms of the FIBROGENHIIT trial (95.3% women; age 53.1 ± 10.2 years). Participants completed a 12-week precision HIIT programme (3 sessions/week), with exercise intensity individually monitored using the FIBROGENHIIT mobile application and Polar H10 heart-rate sensors, enabling real-time physiological monitoring and algorithm-guided exercise progression. Genotype frequencies for HTR2A rs6313 were AA = 7, AG = 32, and GG = 4. Primary outcomes were changes in Fibromyalgia Impact Questionnaire Revised score (Δ FIQR) and pain (Δ VAS). Normality of continuous variables was assessed using the Shapiro–Wilk test. Depending on distributional assumptions, genotype and environmental comparisons were performed using parametric or non-parametric procedures. Gene–environment interaction models were estimated using linear regression with HC3 robust standard errors. Effect sizes, 95% confidence intervals, and model diagnostics were examined throughout.

Results. No statistically significant main effects of HTR2A genotype or exercise environment were observed for Δ FIQR or Δ VAS. However, a biologically plausible gene–environment signal emerged for clinical improvement. Participants carrying the G allele who trained in the outdoor environment tended to show greater FIQR improvement compared with other genotype–environment combinations (interaction coefficient $B = -14.73$, 95% CI -30.12 to 0.67, $p = 0.061$). No comparable signal was observed for pain outcomes. Given the limited sample size and low frequency of the GG genotype, these findings should be interpreted with caution.

Conclusions. Although no robust gene-environment interaction was confirmed, the observed signal involving the HTR2A G allele and outdoor exercise suggests a potentially meaningful biological interaction worthy of further investigation. These preliminary findings support the

feasibility of integrating genetic and environmental factors into future precision exercise medicine approaches for fibromyalgia.

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Award: Yes as Young Researcher (under 35 years)

Abstract 8

EFFECTIVENESS OF WEIGHT LOSS IN OBESE INDIVIDUALS WITH DIFFERENT GENETIC PROFILES IN RESPONSE TO AEROBIC AND RESISTANCE EXERCISE

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Background. The rapid increase in obesity rates in Ukraine over the past four years, in addition to the common determinants observed globally, appears to be further amplified by stressors associated with the ongoing war. Experts have documented a simultaneous rise in the prevalence of prediabetes, diabetes mellitus, and obesity [1,2].

The genetic contribution to body mass index (BMI) in the general population-across the full BMI spectrum-accounts for approximately 40%-50% of its variance after adjustment for age and sex. However, the heritability of BMI and obesity-related traits tends to be lower among individuals of normal weight (30%-35%) and higher among those with obesity or severe obesity (60%-80%). Although the manifestations of obesity can be mitigated through physical exercise, the effectiveness of their application in cases of genetically predisposed metabolic disorders has only been partially established. Aim is to investigate differential response to aerobic and resistance exercise in obese individuals with different genotypes and evaluate whether an obesity-related polygenic risk score (PRS) is associated with the magnitude of body weight change following lifestyle interventions of different modalities.

Methods. The effects of 12-week health-enhancing aerobic and resistance exercise programs on weight reduction and biochemical markers of carbohydrate and lipid metabolism were investigated in adult women with obesity. The study included 109 women with a BMI >30 kg/m² who participated in a structured fitness program combined with a hypocaloric diet (1,500 kcal/day) for 3 months. Participants were divided into three groups: an aerobic training group, a resistance training group, and a non-exercising control group. Laboratory assessments included biochemical markers of lipid and carbohydrate metabolism (glucose, insulin levels), as well as functional indicators of liver and kidney status. Biochemical parameters were determined using enzyme-linked immunosorbent assay (ELISA). Morphometric characteristics were assessed using bioelectrical impedance analysis and standard anthropometry. The training regimen consisted of 3-5 sessions per week, lasting 45-75 minutes each, predominantly involving either strength training (with weights or bodyweight exercises) or moderate-intensity aerobic activity. For comparative analysis of adverse allele frequencies, DNA samples from 387 individuals in a control population were analyzed using the Humess Complex DNA test (300,000 SNPs). An obesity-related PRS was calculated, focusing on single nucleotide polymorphisms (SNPs) within genes known to play key roles in the pathogenesis of obesity, including FTO, MC4R, PPARG, PPARGC1A, LEP, FNDC5, LEPR, ADRB2, ADRB3, APOA2, ADIPOQ, UCP2, UCP3, PLIN1, TCF7L2, GIPR, BDNF, IRS1, TMEM18, and others involved in metabolic regulation.

Overall, a high frequency of risk alleles associated with metabolic dysregulation was observed in the population sample, including: the G allele of rs1801282 (PPARG), linked to insulin resistance and lipid metabolism disturbances; the A allele of rs10423928 (TCF7L2), associated with increased risk of type 2 diabetes and glycemic instability; the G allele of rs1137101 (LEPR), linked to leptin resistance and chronic hyperphagia; the C allele of rs17782313 (MC4R), associated with a higher propensity for overeating under dopaminergic stress; the A allele of rs7799039 and the G allele of rs17300539 (LEP), implicated in disrupted leptin secretion and impaired appetite regulation.

Despite significant reductions in body weight in both intervention groups, no statistically significant association was found between PRS and the degree of weight loss. In the aerobic training group, after correction for multiple testing, only one polymorphism (rs17650401) in the PPARGC1A gene was associated with a more pronounced reduction in fat mass percentage.

Given the absence of a significant interaction between PRS and exercise modality, the effects of aerobic and resistance training on weight reduction appear largely independent of genetic predisposition. These findings support the concept that lifestyle interventions can partially override genetic susceptibility in the management of obesity.

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Award: No

Abstract 9

POLYGENIC ARCHITECTURE OF ACL RUPTURE: EVIDENCE FOR COL12A1 AND HSPG2 GENE–GENE INTERACTIONS ACROSS COHORTS

Firfirey F.*, Rhamoshaba L., Laguette M., Collins M., September A.

Division of Physiological Sciences, Health through Physical Activity, Lifestyle and Sport Research Centre (HPALS), Department of Human Biology, Faculty of Health Sciences, University of Cape Town, South Africa ~ Cape Town ~ South Africa

Background: Anterior cruciate ligament rupture (ACL-R) is a complex musculoskeletal condition influenced by biomechanical, anthropometric, environmental, and polygenic risk factors(1-4). Some of the implicated genetic loci include the COL12A1 rs970547 (C>T) and HSPG2 rs2291826 (A>G), rs2291827 (A>G) polymorphisms (5-7). While COL12A1 and HSPG2 have independently been implicated in ligament biology, it remains unclear whether genetic variation within these loci may collectively modify ACL-R susceptibility. Therefore, this study aimed to investigate the polygenic interaction between the COL12A1 (rs970547 C>T) and the HSPG2 (rs2291826 A>G-rs2291827 A>G) SNPs on ACL-R risk within cohorts from Australia (AUS), Poland (POL), South Africa (SA), and Sweden (SWD).

Methods: The polymorphisms were examined in pooled cohorts including: (i) all four populations (AUS- POL-SA-SWD), (ii) AUS-SA, and (iii) POL-SWD. TaqMan® SNP assays were used to genotype the ACL-R cases (N = 843 [AUS n = 354; POL n = 142; SA n = 252; SWD n = 95]) and controls (N = 581 [AUS n = 84; POL n = 149; SA n = 232; SWD n = 116]). A subgroup of non-contact mechanism of injury (N= 464 [AUS n=165; POL n= 56; SA n=164; SWD n=79]) was also evaluated. Anthropometric and genetic analyses were sex-stratified/standardised. COL12A1 and HSPG2 SNPs were evaluated for inferred allele-allele combinations as a proxy for gene-gene interactions. Appropriate statistical analyses were applied, with significance accepted at $p < 0.05$.

Results: No significant associations were noted for COL12A1 rs970547 C>T SNP in any of the three combined cohorts evaluated, $p > 0.05$. The inferred allele-allele combinations revealed significant associations, $p < 0.05$. In the cohort including all four populations, the T-G-A (CON [14.2%] vs ACL [10.6%]: OR=0.74, 95% CI:0.57–0.97, adjusted $p=0.026$, adjusted haplo.score = -2.22) allele-allele combination demonstrated a protective association. This was also observed within the non-contact (NON [10.0%]: OR = 0.69, 95% CI:0.50-0.95, $p = 0.025$, $hs = -2.25$) subgroup. Furthermore, the T-G-A allele combination was also associated with reduced risk within the Poland-Sweden combined (CON [14%] vs ACL [8.4%]: OR =0.55, 95% CI:0.33-0.90, $p=0.012$, $hs = -2.50$; NON [7.3%] OR = 0.47, 95% CI: 0.24-0.89, $p=0.020$, $hs = -2.33$) cohort.

Conclusion: These findings demonstrate that the COL12A1 and HSPG2 SNPs in combination play a role in ACL-R susceptibility. The analyses showed a protective effect of the T-G-A allele combination within participants of European ancestry. This study highlights the importance of examining polygenic effects in complex phenotypes such as ACL rupture.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 10 (Invited Lecture)

GENETIC MARKERS OF SPORTS PERFORMANCE: FROM CANDIDATE GENES TO MULTI-OMICS INTEGRATION

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Vilnius university ~ Vilnius ~ Lithuania

Athletic performance results from the interplay of biological structure, genetics, and environmental factors. Advances in genomics have revealed molecular mechanisms underlying individual variability in physical capacity, adaptation, and injury risk. The aim of this study was to investigate genotype-phenotype associations in elite Lithuanian athletes by integrating genetic data with functional performance metrics, using both candidate gene analysis and genome wide approaches to identify variants linked to physical performance and injury susceptibility.

Data were obtained from the Lithuanian Elite Athlete DNA Biobank and included 300 genotyped endurance and power-sprint athletes with comprehensive phenotypic profiles. Athletes underwent standardized assessments (body composition, VO_2max , muscle strength). A control group of non athletes ($n=350$) was used for case–control comparisons. Genotyping targeted SNPs related to muscle performance and energy homeostasis (CREM rs1531550, GALNT13 rs10196189, NOS3 rs2070744); cardiovascular adaptation (AGT rs4762, AGTR1 rs5186, AGTR2 rs11091046); metabolic regulation via PPAR pathway genes (PPARA rs4253778, PPARG rs1801282, PPARGC1A rs8192678); and injury susceptibility (MCT1 rs1049434, COL1A1 rs1800012, COL12A1 rs970547). Genotyping was performed using PCR RFLP and real time PCR. A GWAS was conducted to identify novel SNPs associated with athletic phenotypes. Statistical analyses included regression and multivariate models adjusted for age, sex, and physical activity level.

Distinct genotype-phenotype associations were identified. CREM TT, GALNT13 GG, and NOS3 TT genotypes were more prevalent among power-sprint athletes. The AGT CT genotype and AGTR1 C allele were linked to team/combat athletes and male sprinters, respectively. AGTR2 C, PPARG C, and PPARGC1B G alleles were associated with endurance capacity. The PPARA CC genotype correlated with anaerobic traits in males, while PPARA G and PPARG T alleles were favorable in females. Total genotype scores (TGS) suggested that ~60% of the Lithuanian population may carry performance favorable variants, with reduced injury risk observed among football players ($p=0.001$). GWAS revealed a strong association between rs4359550 and elite power–sprint status ($p < 1.1 \times 10^{-7}$). Eight additional SNPs showed suggestive associations ($p < 5 \times 10^{-5}$), including rs3213445 – an exonic variant in the CPT1B gene (p.Ile66Val) potentially affecting fatty acid β oxidation. Three non coding SNPs (rs9453403, rs16937127, rs16947955) were linked to endurance traits, while rs3776751 and rs7195574 were associated with power-sprint phenotypes.

This study identified genetic profiles linked to athletic specialization and injury risk in elite Lithuanian athletes. Integrating candidate gene and GWAS data with phenotypic assessments improved prediction accuracy for performance traits. Transitioning from single SNP analysis to polygenic profiling provides a more comprehensive understanding of genetic contributions to athletic potential.

Ginevičienė V., Utkus A., Pranckevičienė E., Semenova E.A., Hall, E.C. R.; Ahmetov, I.I. Perspectives in sports genomics // Biomedicines. Basel: MDPI. 2022, vol. 10, no. 2, art. no. 298, 1-16. DOI: 10.3390/biomedicines10020298

Award: No

Abstract 11 (Invited Lecture)

BUILDING THE ATHLETE PROFILE: WHAT INFLAMMATORY AND ADRENERGIC GENES CAN TELL US ABOUT EXERCISE RESPONSE

Humińska-Lisowska K.*

Gdansk University of Physical Education and Sport ~ Gdansk ~ Poland

"Inter-individual variability in exercise adaptation is not fully explained by training status or aerobic capacity alone. This study examined whether selected variants in inflammatory and β -adrenergic pathways are associated with fitness-related and exercise-response phenotypes in adults. Up to 962 Polish participants underwent VO_2 max testing, Wingate assessment, anthropometry, blood and biochemical profiling, and genotyping. Analyses focused on IL6, TNF- α , IL15, ADRB2, and ADRB3, using linear models adjusted for age, sex, and BMI, with additional testing of selected SNP–SNP interactions. In the cytokine block, no robust association was observed for VO_2 max in the main-effects model ($p = 0.386$) or after adding pairwise interactions ($p = 0.768$). In contrast, strong signals emerged for other phenotypes. For the fatigue index, adding pairwise interactions significantly improved model fit ($p = 4.995 \times 10^{-8}$), and this effect was driven primarily by the TNF- $\alpha \times$ IL15 interaction ($p = 2.147 \times 10^{-9}$). For hematological traits, the interaction model for hematocrit was significant ($p = 0.0076$), with a robust IL6 $\times$ TNF- α effect ($p = 0.00165$). Similar patterns were observed for hemoglobin, where both the IL6 main effect ($p = 0.0274$) and the IL6 $\times$ TNF- α interaction ($p = 0.0109$) were significant. For RBC, the 3-SNP cytokine model was significant ($p = 0.0373$), with a significant IL6 main effect ($p = 0.0054$). In the β -adrenergic pathway, ADRB2 rs1042713 showed modest but significant associations with selected continuous traits, including VO_2 max ($p = 0.0319$) and mean power ($p = 0.0032$), whereas ADRB3 effects were weaker and no robust ADRB2-ADRB3 interaction was detected. These findings suggest that selected variants in inflammatory and β -adrenergic pathways may be more informative for specific exercise-response phenotypes, particularly fatigue, hematological traits, and continuous performance measures, than for aerobic capacity alone.

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Award: No

Abstract 12 (Invited Lecture)

THE ROLE OF MITOCHONDRIAL MICROPROTEINS IN SKELETAL MUSCLE FUNCTION

Kumagai H.*^[1],

^[1]Tohoku University ~ Sendai ~ Japan, ^[2]University of Southern California ~ Los Angeles ~ United States of America

The Human Genome Project, completed in the early 2000s, identified over 20,000 genes. However, multiple overlooked genomic elements remain, including a class of small proteins known as microproteins. Recent studies have identified previously unannotated microproteins encoded by small open reading frames, and those encoded within the mitochondrial genome are referred to as mitochondrial microproteins, also known as mitochondrial-derived peptides (MDPs). We have discovered several novel mitochondrial microproteins and characterized their biological functions in humans. Among them, MOTS-c, identified in 2015, plays an important role in regulating skeletal muscle metabolism, muscle function, and exercise performance. This talk will provide an overview of mitochondrial microproteins and discuss their roles in skeletal muscle physiology and function.

Award: No

Abstract 13

MULTI-OMICS DISCOVERY OF A MITOCHONDRIAL MICROPROTEIN AS A REGULATOR OF SKELETAL MUSCLE AND A TARGET FOR SARCOPENIA

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Skeletal muscle dysfunction, known as sarcopenia, not only impairs physical function but also increases the risk of morbidity and mortality. Previous studies have suggested that mitochondrial dysfunction triggers muscle loss [1]; however, the precise mechanisms linking mitochondrial function to skeletal muscle atrophy remain unclear. Until recently, mtDNA was believed to encode only 13 proteins. Over the past decade, however, we have identified and characterized multiple previously unannotated peptides, termed mitochondrial microproteins, derived from mtDNA-encoded small open reading frames (smORFs) [2-4]. Despite these advances, no mitochondrial microprotein has yet been discovered primarily as a regulator of skeletal muscle mass or function. The identification of such a mitochondrial microprotein could provide a novel therapeutic target not only for sarcopenia but also for metabolic dysfunction and potentially for reducing mortality risk. Therefore, this study aimed to discover and characterize a novel mitochondrial microprotein that regulates skeletal muscle function by applying genome- and transcriptome-based approaches focused on mitochondrial smORFs.

We analyzed publicly available genetic and transcriptomic datasets to identify a novel mitochondrial microprotein. For genetic analysis, we performed an unbiased mitochondrial-wide association study, a mitochondrial version of genome-wide association studies, to identify functional smORFs encoded in mtDNA by associating mtDNA variation with elite sprint/power athlete status. For transcriptomic analysis, we employed an unbiased smORF expression analysis pipeline adapted from conventional RNA sequencing analysis to optimize smORF detection. To investigate the biological function of the identified microprotein, we used skeletal muscle cells and young mice. A polyclonal antibody against the target microprotein was generated in rabbits using a synthetic peptide corresponding to its amino acid sequence as the antigen.

We analyzed mitochondrial genetic data associated with elite sprint/power athletes, as well as smORF mRNA expression profiles related to aging, obesity, and bed rest in human skeletal muscle. Several single nucleotide polymorphisms associated with elite sprint/power athlete status were found to result in amino acid substitutions in smORF-encoded microproteins. In addition, multiple smORFs were differentially regulated by aging, obesity, and bed rest. By integrating these datasets, we identified an overlapping smORF and discovered a 23-amino acid microprotein, which we named PUTZ (Peptide Under the Alanine Transfer RNA Zone). PUTZ mRNA expression was upregulated in skeletal muscle of elderly individuals, obese subjects, and individuals subjected to bed rest. We confirmed the presence of PUTZ in human primary skeletal muscle cells by Western blotting and mass spectrometry. In vitro, PUTZ treatment significantly reduced metabolic activity, oxygen consumption rate, and myotube size. In vivo, one month of PUTZ administration in young

mice significantly decreased skeletal muscle mass and strength, while increasing fat mass and biomarkers of insulin resistance and inflammation.

Importantly, inhibition of PUTZ appears to be critical for maintaining skeletal muscle function. Lifelong resistance exercise training in older individuals reduced PUTZ mRNA expression in human skeletal muscle, supporting a physiological role for PUTZ regulation. Additionally, PUTZ-neutralizing antibody treatment exhibited effects opposite to those of PUTZ treatment in human skeletal muscle cells, increasing metabolism and promoting muscle growth.

Genome- and transcriptome-based analyses focusing on mitochondrial smORFs identified PUTZ as a novel mitochondrial microprotein that negatively regulates skeletal muscle function. PUTZ is upregulated under catabolic conditions and suppressed by exercise, suggesting a regulatory role in muscle homeostasis and potential as a biomarker. Furthermore, PUTZ inhibition may represent a therapeutic strategy for sarcopenia and frailty through both physiological and pharmacological approaches.

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Award: No

Abstract 14

HTR2A rs6313 and Clinical Response to Precision HIIT: Insights from the FIBROGENHIIT Project.

Massa L.^[1], Meloni M.^[2], Pazzona R.^[2], Fanni M.^[2], Leo P.^[2], Fois F.^[2], Ruggiu M.^[2], Laconi R.^[2], Carta M.G.^[2], Ghiani G.M.^[2], Cięszczyk P.^[3], Tocco F.^[2], Calò C.M.^[4], Massidda M.^[2,3].

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Background: Fibromyalgia is characterized by heterogeneous clinical responses to exercise, supporting the need for precision exercise medicine [1-4].

Objective: This exploratory analysis investigated whether the serotonin receptor 2A gene (HTR2A) rs6313 polymorphism modulates clinical response to high-intensity interval training (HIIT) in the FIBROGENHIIT project.

Methods: This exploratory secondary analysis included 43 patients with fibromyalgia who completed a 12-week precision HIIT programme (3 sessions/week) and had available HTR2A rs6313 genotyping and Revised Fibromyalgia Impact Questionnaire (FIQR) data. The exercise intensity was individually monitored using the FIBROGENHIIT mobile application and Polar H10 heart-rate sensors, enabling real-time physiological monitoring and algorithm-guided exercise progression. The sample was predominantly female (95.3%), with a mean age of 53.1 ± 10.2 years. Primary outcomes were change in FIQR score (Δ FIQR) and FIQR responder status, defined as $\geq 14\%$ improvement, consistent with the published minimal clinically important difference for the original Fibromyalgia Impact Questionnaire (FIQ), with an additional exploratory analysis using a more stringent $\geq 20\%$ responder threshold [5]. Secondary outcomes were the percentage of valid sessions with exercise progression, change in pain assessed by the Visual Analogue Scale (VAS), one-minute heart-rate recovery (HRR1), and Borg rating of perceived exertion. Normality was assessed using the Shapiro-Wilk test. Because Delta FIQR and exercise progression were non-normally distributed, genotype comparisons were performed using Kruskal-Wallis and Mann-Whitney U tests; exploratory adjusted models used heteroscedasticity-robust regression.

Results: Genotype distribution was AA=7, AG=32, and GG=4. Delta FIQR did not differ across genotypes (Kruskal-Wallis $H=0.13$, $p=0.939$, epsilon-squared=0.000), and FIQR responder status was not associated with G-allele carrier status ($\geq 14\%$: Fisher $p=1.000$; $\geq 20\%$: Fisher $p=0.666$). No robust association was observed between HTR2A rs6313 and clinical improvement. A secondary exploratory signal emerged for exercise progression across genotypes (Kruskal-Wallis $H=7.47$, $p=0.024$, epsilon-squared=0.150), with higher median progression in GG carriers; however, the GG group included only four participants. Adjusted exploratory models suggested lower HRR1 in G-allele carriers compared with AA

(beta=-6.60 beats per minute, 95% confidence interval -12.77 to -0.43, p=0.036), but this finding was not confirmed in the allele-dosage model.

Conclusions: In this preliminary FIBROGENHIIT analysis, HTR2A rs6313 was not robustly associated with FIQR-based clinical response to precision HIIT. The observed signals for exercise progression and autonomic recovery should be interpreted as hypothesis-generating and require confirmation in larger, genetically balanced cohorts.

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Award: Yes as Young Researcher (under 35 years)

Abstract 15

COMPARATIVE EFFECTS OF TWO PROBIOTIC FORMULATIONS ON AEROBIC METABOLISM-RELATED DNA METHYLATION

Proia P.*^[1], Boatta A.^[2], Messina G.^[2], Cardinale P.S.^[3], Alioto A.^[1], Pagliaro A.^[1], Volpes S.^[3], Baldassano S.^[3], Naselli F.^[3]

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Physical activity and nutritional interventions can influence metabolic adaptation through epigenetic mechanisms, including DNA methylation [1]. In particular, probiotics may modulate host metabolic and inflammatory pathways, potentially affecting the methylation status of genes involved in aerobic metabolism [2]. Understanding whether different probiotic formulations exert distinct epigenetic effects may help define targeted non-pharmacological strategies to support exercise-related adaptation and health [3]. Evaluate changes in gene-specific DNA methylation related to aerobic metabolism after probiotic supplementation and to compare the effects of two different probiotic formulations: one containing Lactobacillus and Bifidobacterium and one containing only Lactobacillus.

Participants underwent a 12-week probiotic supplementation protocol using a formulation containing Lactobacillus and Bifidobacterium, followed, after a break, by a second 12-week supplementation period using a probiotic formulation containing Lactobacillus. Biological samples were collected before and after each intervention phase. Epigenetic analyses were performed to assess global and gene-specific DNA methylation patterns, with a particular focus on genes involved in aerobic energy metabolism. Methylation profiles were compared before and after each supplementation phase and between the two probiotic formulations to identify formulation-related differences.

Probiotic supplementation has been associated with changes in DNA methylation in genes related to aerobic metabolism. A comparison of the two supplementation phases revealed distinct epigenetic responses, suggesting that the composition of probiotics may differentially influence pathways involved in metabolic efficiency and inflammatory regulation. In particular, the formulation containing Lactobacillus and Bifidobacterium appeared to exert a greater modulatory effect on specific methylation targets compared to the formulation containing only Lactobacillus.

The two probiotic formulations induced different gene-specific DNA methylation responses in pathways related to aerobic metabolism in the same participants. The combined formulation of Lactobacillus and Bifidobacterium appeared to produce a stronger epigenetic modulation than Lactobacillus alone, supporting a formulation-specific effect of probiotic supplementation on exercise-related metabolic adaptation.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 16 (Invited Lecture)

RETHINKING ACL INJURY RISK: POLYGENIC REGULATION OF MECHANOBIOLOGY, ANGIOGENESIS AND EXTRACELLULAR MATRIX HOMEOSTASIS

September A.*

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Connective tissue injuries such as anterior cruciate ligament (ACL) ruptures are characterised by marked inter-individual variability in susceptibility and healing outcomes. Emerging evidence suggests that ligament homeostasis is governed by integrated biological networks involving mechanotransduction, angiogenesis, inflammation, extracellular matrix (ECM) remodelling, and cellular signalling. Interestingly, many of these same pathways are disrupted in microgravity and unloading environments, where altered mechanical loading influences endothelial function, fibroblast behaviour, collagen organisation, and ECM homeostasis. These observations provide a unique mechanobiological framework through which connective tissue injury susceptibility may be explored.

The angiogenesis pathway plays a central role in ligament healing and graft remodelling following ACL reconstruction. Increasing evidence suggests that vascular regulation within ligament tissue is influenced by cross-talk between extracellular matrix proteoglycans and pro-inflammatory signalling pathways. In this context, we investigated polygenic interactions between variants in the angiogenic regulator VEGFA and the extracellular matrix proteoglycan gene HSPG2 in a multi-centre cohort from Poland, Sweden, Australia, and South Africa.

Variants within VEGFA (rs699947, rs2010963) and HSPG2 (rs2291826, rs2291827) were analysed in 579 asymptomatic controls and 833 individuals with ACL ruptures, including 434 non-contact injuries. Allelic combinations were constructed to model gene–gene interactions and analysed according to sex and population structure, using permutation-based statistical approaches.

Specific allelic combinations involving VEGFA and HSPG2 were significantly associated with reduced ACL rupture risk across combined and population-specific cohorts, with stronger effects observed in males. Several associated variants are known expression quantitative trait loci, suggesting that regulatory genetic variation contributes to the homeostatic control of angiogenesis and ECM organisation.

Collectively, these findings support a network-based model of ligament injury susceptibility in which coordinated regulation between angiogenic and extracellular matrix pathways influences tissue integrity and resilience. The work further highlights the importance of integrating population genetics, systems biology, and mechanobiology to advance precision approaches to connective tissue injury risk and repair.

Award: No

Abstract 17 (Invited Lecture)

GENETIC SUSCEPTIBILITY TO NON-CONTACT INJURIES IN ELITE ADOLESCENT ACADEMY FOOTBALL PLAYERS: EVIDENCE FROM SPAIN (LES5G STUDY)

Yvert T.*

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Background: Non-contact injuries represent a major burden in elite football and are particularly prevalent during adolescence, a period characterised by rapid musculoskeletal development and increasing training demands. While extrinsic risk factors are well documented, interindividual differences in injury susceptibility related to genetic variability remain poorly understood.

Purpose: To investigate the association between genetic polymorphisms involved in soft-tissue structural properties, repair and regeneration, and extracellular matrix regulation, and the incidence and severity of non-contact injuries in Spanish elite adolescent academy football players.

Methods: Male players from an elite Spanish football academy (Getafe CF) were prospectively monitored for non-contact injuries. Selected genetic polymorphisms previously associated with muscle and soft-tissue injuries were analysed. Injury incidence and severity were assessed using time-loss duration. Relevant covariates related to body composition, physical activity, nutrition, sleep, and psychological factors were considered.

Results: Preliminary analyses indicate that specific genetic variants are associated with differences in non-contact injury incidence and severity.

Conclusion: These preliminary findings suggest that genetic variability may contribute to non-contact injury susceptibility in elite adolescent football players.

Award: No

Abstract 18

STRAIN-DEPENDENT EFFECTS OF PROBIOTIC SUPPLEMENTATION ON HEAT SHOCK PROTEIN EXPRESSION IN RESPONSE TO EXERCISE

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Heat shock proteins (HSPs) play a central role in cellular homeostasis and stress adaptation during exercise. Among them, HSP60 is mainly associated with mitochondrial protein folding and metabolic adaptation, HSP70 is involved in general cytoprotection, and HSP90 is linked to stress-responsive signalling pathways[1], [2]. Probiotic supplementation may influence these molecular responses by modulation systemic inflammation, metabolic efficiency and exercise-related cellular stress. However, the effects of different probiotic strains on HSP expression remain poorly understood [3]. Evaluate the effects of probiotic supplementation on HSP60, HSP70 and HSP90 expression following exercise, paying particular attention to the molecular response of different strains. The study examined the effects of two probiotic formulations: one containing both *Lactobacillus* and *Bifidobacterium*, and another containing only *Lactobacillus*, in order to evaluate the impact of different strains on the molecular response.

The same participants completed two separate 12-week probiotic supplementation phases, each based on different probiotic strains and separated by an interval period. Biological samples were collected before and after each intervention phase. The protein expression levels of HSP60, HSP70, and HSP90 were assessed using Western blot analysis. Pre- and post-supplementation profiles were compared to identify exercise-related and strain-dependent changes in heat shock protein expression.

Probiotic supplementation has been associated with distinct changes in the expression of heat shock proteins. HSP70 levels remained essentially unchanged between the pre- and post-intervention assessments, which suggests that baseline cytoprotective activity was maintained. In contrast, HSP60 and HSP90 expression decreased following supplementation. The decrease in HSP90 may reflect a reduced need for stress-related signalling and the inflammatory response. Meanwhile, the reduction in HSP60 may indicate changes in adaptive mitochondrial signalling following probiotic intake. Overall, these results suggest that different probiotic strains may modulate the cellular stress response induced

by exercise, shifting the molecular profile towards a less stress-responsive state. This effect was particularly evident in the formulation containing both *Lactobacillus* and *Bifidobacterium*, compared to the formulation containing only *Lactobacillus*.

Probiotic supplementation induced a selective modulation of heat shock protein expression following exercise. While HSP70 levels remained stable, HSP60 and HSP90 levels decreased after supplementation, indicating a differential effect on mitochondrial and stress-related pathways. These results confirm the strain-dependent role of probiotics in determining the molecular response to exercise and suggest their potential relevance in non-pharmacological strategies aimed at improving cellular adaptation and metabolic homeostasis.

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Award: Yes as Young Researcher (under 35 years)

Abstract 19

NUTRITIONAL IMPACT OF SHORT-TERM SODIUM BUTYRATE SUPPLEMENTATION ON BIOACTIVE FATTY ACID- DERIVED LIPID MEDIATORS IN HEALTHY ADULTS

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Butyrate, a short-chain fatty acid produced by the gut microbiota from nondigestible carbohydrates, supports gut homeostasis and regulates systemic energy balance (1) ; however, its metabolic effects in humans remain poorly characterized. This study investigates the short-term metabolic effects of sodium butyrate (NaB) supplementation in healthy individuals by analyzing plasma fatty acid profiles and their bioactive lipid mediators involved in energy metabolism.

Twelve healthy subjects (20–65 years; BMI 22 ± 3.8 kg/m²) received a single oral dose of 600 mg NaB (Butyrose®, SILA Spa) or placebo after an overnight fasting. Blood samples were collected at baseline and at 1, 2, and 3 hours post-intake. Plasma fatty acids and lipid mediators were quantified by HPLC-DAD, GC-FID, and UHPLC-ESI-MS/MS. Data were analyzed using repeated-measures mixed-effects models.

NaB supplementation vs placebo was associated with a significant time-dependent increase in circulating non-esterified fatty acids (NEFAs), including palmitoleic acid (16:1), oleic acid (18:1), and docosahexaenoic acid (22:6). A significant increase in palmitoleoylethanolamide (POEA) and a trend toward increased oleoylethanolamide (OEA), derived from 16:1 and 18:1 respectively, were also observed. Plasma fatty acid levels remained unchanged. Acute NaB supplementation modulated circulating lipid mediators during fasting, increasing NEFAs and the ethanolamides OEA and POEA. The rise in these endogenous ligands of peroxisome proliferator-activated receptor (PPAR) α , a key regulator of fatty acid oxidation, suggests a potential shift toward enhanced lipid mobilization and oxidative metabolism. Moreover, OEA and POEA may engage GPR119 signaling, a pathway involved in energy metabolism, thereby contributing to lipid–glucose metabolic interplay under fasting conditions.

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Award: Yes as Young Researcher (under 35 years)

Abstract 20

SYMMETRY OF THE UPPER AND LOWER LIMBS IN STREETLIFTING ATHLETES

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BACKGROUND. Streetlifting is a recently emerging sport that combines elements of calisthenics and strength training, where athletes compete in established weight categories and aim to lift maximal external loads. Despite increasing popularity, to date scientific literature on streetlifting athletes appears very limited [1,2]. **OBJECTIVE.** The aim of this study was to investigate the anthropometric, functional and body composition characteristics in a sample of streetlifting practitioners, with particular emphasis on identifying potential asymmetries between body sides.

METHODS. Fourteen male athletes (mean age 27.2 ± 5.6 years) underwent anthropometric, whole-body and segmental bioelectrical impedance measurements, and handgrip strength test. Bioelectrical data were analysed using semi-quantitative approaches, namely phase angle (PhA) and specific bioelectrical impedance vector analysis (spBIVA). Paired-sample t-tests were applied to investigate differences between body sides. Comparisons with male athletes of similar age practicing other sports (tennis: 20 athletes, bodybuilding: 16, and kettlebell sport [3]: 11) were conducted through confidence ellipses and Hotelling's T2 test.

RESULTS. The sample showed a mean BMI of 25.7 ± 1.7 . Individual vectors plotted on spBIVA tolerance ellipses were shifted toward the left side, indicating higher PhA values than the reference population, suggestive of greater cellular integrity and higher relative intracellular water content. Differences between contralateral limbs were limited to upper limb length ($p = 0.007$), with body composition measures showing no significant differences. Compared with athletes from other sports, streetlifters exhibited different upper limb composition features ($p < 0.001$), showing a higher fat mass percentage, whereas lower limb composition did not differ from that of other sports (data comparable just for bodybuilding or kettlebell athletes).

CONCLUSIONS. Streetlifting athletes exhibit overall symmetry in anthropometric, body composition, and strength measures, suggesting that the bilateral nature of the sport preserves and promotes functional and morphological balance. Compared with other disciplines, upper limb composition appears peculiar, whereas lower limb composition is similar. Taken together, these findings provide novel insights into structural and functional adaptations in an emerging strength and power sport and support the potential relevance of streetlifting for maintaining symmetry in athletes exposed to unilateral loading patterns.

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Award: Yes as Young Researcher (under 35 years)

Abstract 21

CAFFEINE WITHDRAWAL AND EXERCISE PERFORMANCE. A SYSTEMATIC REVIEW AND STUDY PROTOCOL.

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Caffeine is one of the most widely used ergogenic aids, known to enhance both physical and cognitive performance primarily through adenosine receptor antagonism [1,2]. However, chronic consumption may induce tolerance, reducing its acute effectiveness [3]. Short-term caffeine withdrawal is commonly proposed as a strategy to restore sensitivity, yet the scientific evidence supporting this approach remains inconsistent. Therefore, the aim of this study was to systematically synthesize current evidence on the effects of caffeine withdrawal on exercise performance, and to present an experimental protocol designed to investigate physiological and cognitive responses to caffeine re-administration following abstinence.

A systematic review was conducted in accordance with PRISMA guidelines. Electronic databases (PubMed, Scopus, Web of Science, EBSCO) were searched for studies examining caffeine withdrawal followed by acute caffeine ingestion prior to exercise testing in healthy individuals. The search strategy included the following keywords: ("caffeine withdrawal" OR "caffeine abstinence" OR "caffeine washout") AND ("exercise performance" OR "ergogenic effect" OR "performance enhancement"). Studies assessing exercise performance outcomes were included. Based on the identified research gap, a randomized, double-blind, placebo-controlled crossover study is proposed. Physically active participants will undergo a 7-day caffeine withdrawal period followed by acute caffeine supplementation. Performance will be assessed using Wingate test, countermovement jump, handgrip strength. Cognitive function will be evaluated using the Flanker task. Venous blood samples will be collected at baseline, post-ingestion, and post-exercise to determine epinephrine and norepinephrine concentrations.

Current evidence indicates that acute caffeine ingestion consistently improves exercise performance; however, short-term withdrawal (≤ 4 days) does not meaningfully enhance these ergogenic effects [4,5]. Some studies suggest that longer abstinence periods (≥ 7 days) may partially restore physiological responsiveness, particularly in individuals with high habitual caffeine intake [5]. Overall, the available literature is limited by small sample sizes, inconsistent withdrawal protocols, and variability in study design, which contribute to heterogeneous findings and limit the strength of conclusions.

Short-term caffeine withdrawal does not appear to significantly augment the ergogenic effects of caffeine. However, longer abstinence may partially restore responsiveness in habitual users. The proposed study aims to address current limitations by integrating performance, cognitive, and physiological measures, providing a more comprehensive evaluation of caffeine withdrawal as a potential strategy in sport.

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Award: No

Abstract 22

CONJUGATED LINOLEIC ACID PROMOTES ANTI-INFLAMMATORY AND CHONDROGENIC MSC PHENOTYPES THROUGH LIPID METABOLIC REMODELING IN 2D AND 3D COLLAGEN SCAFFOLDS FOR CARTILAGE REPAIR

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Articular cartilage damage from trauma or osteoarthritis (OA) remains a major challenge due to limited regenerative capacity and chronic inflammation [1]. Conjugated linoleic acid (CLA), a fatty acid (FA) enriched in grass-fed dairy, exhibits neuro-anti-inflammatory activity through activation of peroxisome proliferator-activated receptor- α (PPAR- α), a key regulator of mesenchymal stem cell (MSC) differentiation [2]. This study explores CLA's therapeutic potential to modulate inflammation and enhance MSC-driven chondrogenesis in 2D and 3D biomimetic collagen-based scaffolds previously engineered for stable, hyaline-like cartilage repair [3,4].

Human umbilical cord-derived MSCs were cultured in 2D under growth media and in 3D under chondrogenic conditions. In 2D, cells were treated for 4 and 7 days with 25 μ M CLA. FA and N-acylethanolamine (NAE) profiles, and expression of inflammatory genes (MMP-3, MMP-13), were analyzed. In 3D, MSCs were seeded into collagen-based scaffolds fabricated by lyophilisation [3] and cultured for 28 days with or without IL-1 β and CLA, assessing lipid metabolism, sGAG and DNA content, gene expression, and histological matrix properties.

In 2D, CLA was successfully incorporated and metabolized to CD16:2 via peroxisomal β -oxidation, supporting PPAR- α activation and lipid remodeling toward anti-inflammatory pathways. CLA also increased synthesis of the n-3 FA docosahexaenoic acid (DHA) and its bioactive amide, N-docosahexaenoylethanolamine (DHAEA). These metabolic shifts coincided with downregulation of MMP-3 and MMP-13, indicating reduced inflammation and matrix degradation. Comparable metabolic patterns occurred in 3D scaffolds, confirming CLA's regulation of MSC lipid homeostasis. In 3D, CLA maintained high levels of DNA and sGAG without inducing mineralisation, while histology confirmed homogeneous cell distribution and robust cartilage-like matrix formation.

Taken together, CLA modulated MSC lipid metabolism via peroxisomal β -oxidation, enhancing anti-inflammatory lipid mediator synthesis and downregulating key catabolic markers (MMP-3 and MMP-13) in 2D, while in 3D it preserved metabolic and anti-inflammatory effects supporting cartilage-like tissue formation without hypertrophy. These results identify CLA as a bioactive FA capable of modulating inflammation and metabolism during chondrogenesis, highlighting its therapeutic promise for MSC- and biomaterial-based cartilage repair strategies in inflammatory joint environments.

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Award: Yes as Young Researcher (under 35 years)

Abstract 23

DOES THE FORM MATTER? EFFECTS OF DIFFERENT SODIUM BICARBONATE DELIVERY FORMS ON GASTROINTESTINAL SYMPTOMS AND ANAEROBIC PERFORMANCE

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Background: Sodium bicarbonate (NaHCO_3) is a well-established ergogenic aid in high-intensity exercise; however, its use is often limited by gastrointestinal (GI) discomfort. Modified delivery forms, such as enteric-coated capsules, may improve tolerance and influence performance outcomes through altered absorption kinetics.

Objective: To compare the effects of different sodium bicarbonate delivery forms on gastrointestinal symptoms and anaerobic performance in physically active individuals.

Methods: A randomized, double-blind, placebo-controlled crossover design was employed. Participants completed three experimental conditions involving different forms of sodium bicarbonate supplementation and placebo. Each trial included two 30-second Wingate tests separated by a 5-minute recovery period. Performance variables included peak power, mean power, total work, and fatigue indices. Gastrointestinal symptoms were assessed using standardized questionnaires. Blood markers of buffering capacity were also collected (analysis ongoing).

Results: Significant effects of supplementation form were observed for mean power during both the first and second Wingate tests ($p = 0.036$ and $p = 0.038$, respectively), with the highest values recorded in one active condition. While total work showed a non-significant trend in the second Wingate test ($p = 0.085$), it did not reach significance in the first test ($p = 0.157$). Following data correction, no significant differences were observed for absolute or relative peak power ($p > 0.05$), time to peak power, or fatigue indices across any conditions. Overall, these results robustly indicate that sodium bicarbonate primarily enhances performance variables associated with sustained power output (mean power) rather than maximal or fatigue-related parameters.

Conclusions: The ergogenic effects of sodium bicarbonate appear to depend on the form of administration and are most pronounced in parameters related to maintaining high-intensity output. The absence of changes in fatigue indices suggests that NaHCO_3 enhances overall work capacity without altering fatigue dynamics. These findings support the importance of optimizing delivery form to balance efficacy and tolerability.

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Award: No

Abstract 24

NUTRITIONAL CONSIDERATIONS IN BREATH-HOLD DIVING: A FOCUS ON NUTRITIONAL DEFICIENCIES AND MICRONUTRIENT INTAKE

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Breath-hold diving (BHD) imposes unique physiological demands on oxygen transport and metabolic efficiency, yet micronutrient intake in BH divers remains unreported, warranting investigation to support their health and performance. The aim of this study was twofold: first, to examine self-reported dietary deficiencies in a large international sample of competitive and non-competitive BH divers using a structured online questionnaire; and second, to assess the dietary intake of key micronutrients involved in erythropoiesis—iron, vitamin B12, and folate—in a small national sample of 26 Greek competitive BH divers using dietary recalls.

This cross-sectional study comprised two components conducted during the 2024/2025 competitive season. An international sample of 336 BH divers aged ≥ 18 years was recruited via social media to complete a structured online questionnaire (Google Forms) assessing nutritional habits, including self-reported clinically diagnosed micronutrient deficiencies. Group differences were assessed using the Chi-square test, with 95% confidence intervals and statistical significance set at $p < 0.05$, using SPSS version 29.0. Additionally, 26 Greek competitive BH divers aged ≥ 18 years, who trained at least twice weekly, were recruited during indoor season through BHD clubs in Athens. Participants completed two 24-hour dietary recalls—one on a training day and one on a rest day. Micronutrient intake was analyzed using the Cronometer App, and the mean intake across the two days was reported.

The international sample included 210 male (62.5%) and 126 female (37.5%) BH divers (mean age 40.9 ± 9.5 years), of whom 218 (64.9%) were active competitors and 63 (18.8%) were non-competitors. The most frequently self-reported deficiencies among all divers were iron (16.1%), vitamin D (12.5%), and vitamin B12 (6.5%). Iron deficiency was higher in competitors than non-competitors (18.3% vs. 14.3%) but not statistically significant ($p = 0.575$), while vitamin B12 deficiency was similar between groups (6.88% vs. 4.76%). The Greek sample comprised 26 competitive BHD athletes (24 males, 4 females; mean age 40.8 ± 8.3 years). Mean daily intakes were 7.9 ± 3.8 mg iron in males and 6.45 ± 3.3 mg in females, 5.9 ± 10.7 μ g vitamin B12, and 222.7 ± 146.9 μ g folate. All four female and 14 male divers (69.2% of the sample) failed to meet the iron Recommended Dietary Allowances (RDA), nine divers (34.6%) fell below the vitamin B12 RDA, and 23 (88.5%) did not meet folate recommendations.

These findings highlight a substantial burden of dietary micronutrient inadequacies among BH divers. Iron was the most commonly self-reported diagnosed deficiency in the international sample, with all females and over half of the males in the Greek sample failing to meet the RDA. A key nuance is that iron absorption can be influenced by dietary inhibitors

or enhancers and by hepcidin regulation (1, 2); hepcidin levels may be elevated by inflammation or suppressed by hypoxia, both of which are relevant to BHD. Vitamin B12 intake was variable, and most athletes did not meet folate requirements. Importantly, questions arise regarding RDAs, as they are based on the general population and may underestimate the requirements of endurance athletes repeatedly exposed to hypoxia. In addition, restrictive dietary practices and low energy availability—common in a sports that emphasize energy efficiency—may exacerbate micronutrient insufficiencies, potentially affecting hematological biomarkers and, consequently, oxygen-carrying capacity, exercise tolerance, and endurance performance (3). Limitations of the study include the cross-sectional design, self-reported dietary data, use of a commercial dietary analysis tool, short assessment period, absence of biochemical markers, and a small, country-specific sample. Future research should include direct hematological assessments and longitudinal monitoring of micronutrient status and energy availability in BH divers, along with evaluation of dynamics and interplay of hepcidin and inflammatory biomarkers in relation to BHD training, to inform optimized iron intake strategies in this sport.

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Award: Yes as Young Researcher (under 35 years)

Abstract 25

DIETARY HABITS IN BREATH-HOLD DIVERS: ASSESSING DIETARY PATTERNS, ENERGY AVAILABILITY AND MACRONUTRIENT INTAKE

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Breath-hold diving (BHD) is an underwater sport that requires sustained muscular work under limited oxygen availability. BH divers constantly expand the limits of human performance, yet little is known about their dietary patterns. The sport's emphasis on energy efficiency may increase the risk of low energy availability (LEA)—defined clinically as <30 kcal/kg fat-free mass (FFM)/day and subclinically as 30–45 kcal/kg FFM/day—which is associated with endocrine disruption, reduced bone mineral density, immune dysfunction, gastrointestinal disturbances, impaired recovery, increased injury risk, and compromised performance, and is often linked to insufficient carbohydrate intake (recommended 3–12 g/kg body mass [BM]/day), while adequate protein intake (1.2–2.0 g/kg BM/day) remains essential to preserve FFM and support recovery, particularly during energy restriction (1). The aim of the study was to examine dietary patterns of an international sample of competitive and non-competitive BH divers, as well as to assess EA and macronutrient intake in a sample of 26 Greek competitive BH divers.

This cross-sectional study was conducted in 2024/2025 competitive season. First, an international sample of 336 BH divers aged ≥ 18 years was recruited via social media and completed a structured online dietary questionnaire through Google Forms. Second, during indoor season, 26 Greek BH athletes aged ≥ 18 years who trained at least twice weekly were recruited through BHD clubs and underwent DXA-based body composition assessment. Participants also completed two 24-hour dietary recalls, including one rest day and one BHD training day, which was analyzed using the Cronometer App to determine macronutrient and energy intake (EI). EA was calculated using DXA-derived FFM and EI, with exercise energy expenditure set to zero for the rest day and estimated for the training day based on training duration, DXA-derived BM, and a value of 11.5 METs, corresponding to moderate-intensity BHD (2).

The international sample included 210 male (62.5%) and 126 female (37.5%) BH divers (mean age 40.9 ± 9.5 years). Nearly half (45.8%) reported following no specific diet, while common dietary patterns included high-protein (16.7%), intermittent fasting (15.2%), vegetarian (11.6%), lactose-free (10.4%), gluten-free (8.6%), Mediterranean (8.3%), vegan (3.9%), and ketogenic or energy-restrictive diets (3.3% each). Additionally, 14.6% often or always restricted energy intake and 14.3% practiced water fasting to enhance performance. Among females, 16.8% reported irregular menstrual cycles. The Greek sample included 24 male and 4 female divers (mean age 40.8 ± 8.3 years; BMI 25.8 ± 3.0 kg/m²). Mean EA was 28.3 ± 10.6 kcal/kg FFM/day on the rest day and 14.2 ± 11.9 kcal/kg FFM/day on the training day. Averaging both days, 23 divers (88.5%) met the criteria for LEA, while 2 (7.7%) met criteria for subclinical LEA. Mean carbohydrate intake was 1.4 ± 0.7 g/kg BM on the rest day

and 1.8 ± 0.8 g/kg BM on the training day; protein intake was 1.2 ± 0.7 g/kg BM on the rest day and 1.3 ± 0.7 g/kg BM on the training day.

If not properly planned, dietary patterns restricting lactose, gluten, or animal foods may reduce intake of key macro- and micronutrients—carbohydrates, protein, iron, calcium, and vitamin B12—potentially compromising bone and hematological health. In addition, intermittent fasting, ketogenic, and energy-restrictive diets may precipitate or worsen LEA. In the Greek sample, EA was generally low—particularly on training days—with most divers meeting criteria for LEA; carbohydrate intake was notably inadequate on training days, whereas protein intake appeared sufficient. The finding that some female divers had irregular menstrual cycles suggests that some athletes may already be experiencing reproductive dysfunction associated with LEA or inadequate nutrient intake. Study limitations include cross-sectional design, self-reported dietary data, the use of a commercial dietary analysis tool, short assessment period, and small country-specific sample. Routine LEA screening and targeted nutrition education for BH divers are recommended.

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Award: Yes as Young Researcher (under 35 years)

Abstract 26

NUTRITIONAL STATUS AND BODY COMPOSITION IN PERSONALIZED HIIT RESPONSE: EVIDENCE FROM THE FIBROGENHIIT STUDY

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Background: Nutritional status and body composition may influence clinical responsiveness to personalized high-intensity interval training (HIIT) in fibromyalgia, but their role within multidomain precision-exercise models remains insufficiently defined [1-4].

Objective: To determine whether baseline food-frequency and body-composition variables contribute to personalized HIIT response in the FIBROGENHIIT study.

Methods: This secondary exploratory analysis used the FIBROGENHIIT dataset and included exercise-arm participants with valid Fibromyalgia Impact Questionnaire-Revised (FIQR) responder data. The primary outcome was FIQR 20% responder status; the secondary outcome was absolute FIQR improvement. Candidate predictors included baseline body composition, food-frequency questionnaire (FFQ) variables, demographics, clinical questionnaires, functional tests, cardiopulmonary exercise testing, Indoor/Outdoor environment, and HTR2A rs6313 genotype. Post-intervention variables and response-derived variables were excluded from the primary predictive model. Normality was assessed using Shapiro-Wilk tests. Univariate analyses used Welch t-tests or Mann-Whitney U tests for continuous predictors and chi-square tests for categorical predictors. Least absolute shrinkage and selection operator (LASSO) logistic regression was used as a penalized screening method; because no stable non-zero predictor was retained, the strongest nutritional/body-composition signal was tested in an exploratory logistic model [5].

Results: The analysis included 63 exercise-arm participants; mean age was 52.0 ± 10.5 years, body mass index was 26.3 ± 4.2 kg/m², fat mass was $37.1 \pm 6.3\%$, and FIQR 20% response was observed in 19/63 (30.2%). The strongest overall baseline signal for responder status was baseline vigor (MFSI-SF Vigor subscale) (Welch t-test, effect=-0.58, p=0.016). Among nutritional/body-composition variables, the strongest binary-response signal was baseline cheese and dairy product intake (FFQ) (Mann-Whitney U, effect=-0.36, p=0.021). For continuous FIQR improvement, the strongest nutritional/body-composition association was baseline trunk fat percentage (Spearman rank correlation, $r=-0.29$, 95% confidence interval -0.51 to -0.03, p=0.028). In the exploratory logistic model evaluating the strongest nutritional signal, FFQ_Formaggi_Latticini_T0 was not an independent predictor (odds ratio=0.90, 95% confidence interval 0.74 to 1.08, p=0.252; apparent area under the curve=0.70).

Conclusions: Baseline nutritional and body-composition variables showed exploratory associations with personalized HIIT response, but they did not provide robust independent prediction after penalized screening. These findings support the inclusion of nutritional/body-composition profiling in multidomain precision-exercise assessment, while emphasizing that clinical response is unlikely to be explained by isolated anthropometric or dietary markers.

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Award: Yes as Young Researcher (under 35 years)

Abstract 27

CARDIORESPIRATORY ADAPTATIONS TO PRECISION HIIT IN FIBROMYALGIA: CPET FINDINGS FROM THE FIBROGENHIIT PROJECT.

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Background: Precision exercise prescription in fibromyalgia requires objective evaluation of cardiorespiratory adaptation to structured high-intensity interval training (HIIT). Cardiopulmonary exercise testing (CPET) provides an integrated measure of aerobic capacity, workload tolerance and cardiovascular response, but CPET-derived adaptations after personalized HIIT remain insufficiently characterized in this population.

Objective: To evaluate cardiorespiratory adaptations to precision HIIT in patients with fibromyalgia enrolled in the FIBROGENHIIT Project and to explore multidomain predictors of relative VO₂peak improvement (1-4).

Methods: This secondary exploratory analysis used the FIBROGENHIIT dataset and included participants allocated to Indoor or Outdoor precision HIIT with complete CPET data at baseline (T0) and post-intervention (T1). Participants completed a 12-week precision HIIT programme (3 sessions/week), with exercise intensity individually monitored using the FIBROGENHIIT mobile application and Polar H10 heart-rate sensors, enabling real-time physiological monitoring and algorithm-guided exercise progression. The primary outcome was change in VO₂peak, expressed as both absolute change and percentage change from baseline. Secondary CPET outcomes included maximal workload, VO₂ at ventilatory threshold 1, FatMax, maximal heart rate and exercise blood pressure. Normality was assessed using Shapiro-Wilk tests. Paired t-tests or Wilcoxon signed-rank tests were selected according to distributional assumptions. Multidomain predictors of percentage VO₂peak change were explored using univariate correlation screening, LASSO selection and a parsimonious linear regression model (5).

Results: The analysis included 34 participants (age 52.3 ± 10.3 years; 32/34 women, 94.1%). VO₂peak increased from 18.06 ± 3.83 to 20.21 ± 3.97 ml/kg/min (median change 2.50 [-0.75; 6.00]; Wilcoxon p=0.014; rank-biserial r=0.50). Nineteen participants (55.9%) were classified as CPET responders. Systolic and diastolic exercise blood pressure decreased significantly (PAS p=0.001; PAD p<0.001), whereas maximal workload, VO₂VT1 and FCmax did not show statistically robust changes. In exploratory prediction analyses, lower baseline VO₂peak was the most consistent independent predictor of greater relative VO₂peak improvement (B=-3.12 percentage points per ml/kg/min, 95% CI -5.43 to -0.81, p=0.010; standardized beta=-0.44).

Conclusions: Precision HIIT was associated with significant improvement in VO₂peak and a favorable exercise blood-pressure profile in this CPET subcohort of patients with

fibromyalgia. The strongest and most interpretable predictor of relative aerobic adaptation was lower baseline aerobic capacity, supporting CPET as a clinically useful tool to identify patients with greater potential for cardiorespiratory gain during personalized exercise prescription.

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Award: Yes as Young Researcher (under 35 years)

Abstract 28

EFFECTS OF ENTERIC-COATED AND STANDARD SODIUM BICARBONATE CAPSULES ON GASTROINTESTINAL SYMPTOMS DURING EXERCISE.

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Sodium bicarbonate is a supplement with well-documented ergogenic effects [1]; however, its use may be associated with gastrointestinal symptoms such as nausea, bloating, and abdominal pain, particularly at higher doses [1]. It has been suggested that the use of enteric-coated capsules may reduce these adverse effects by minimizing contact of the substance with the gastric mucosa and enabling more controlled release [2,4]. Despite growing interest in different forms of supplementation, there is still a lack of studies comparing their effects on gastrointestinal symptoms under exercise conditions [3,5]. The aim of the study was to assess the effect of the form of sodium bicarbonate supplementation on the severity of gastrointestinal symptoms before and after exercise.

Eighteen physically active men participated in three experimental sessions in a randomized, double-blind, crossover design (standard capsule, enteric-coated capsule, and placebo). Supplementation (0.3 g/kg body mass) was administered 2 hours before exercise. Gastrointestinal symptoms were assessed seven times using a 0–10 scale, and the measurements were subsequently averaged for the pre- and post-exercise periods.

Friedman test analysis revealed a significant effect of supplementation condition on nausea severity ($\chi^2 = 6.588$; $p = 0.037$; Kendall's $W = 0.183$) and abdominal pain ($\chi^2 = 6.000$; $p = 0.050$; Kendall's $W = 0.167$). Post hoc analysis showed significantly higher nausea severity in the first condition compared to the second condition ($\Delta = 0.43$; $p_{\text{bonf}} = 0.040$), as well as greater abdominal pain severity in the first condition compared to the third condition ($\Delta = 0.50$; $p_{\text{bonf}} = 0.048$).

Analysis of time-related changes using the Wilcoxon signed-rank test demonstrated a significant increase in nausea severity after exercise in the second condition (pre: 0.07 ± 0.18 vs post: 0.47 ± 0.86 ; $p < 0.05$), as well as an increase in the urge to vomit (pre: 0.02 ± 0.08 vs post: 0.29 ± 0.57 ; $p < 0.05$). In contrast, a significant decrease in bloating severity after exercise was observed in the first condition (pre: 1.28 ± 1.06 vs post: 0.60 ± 0.92 ; $p < 0.05$).

No significant differences between conditions were found for intestinal cramps, bloating, or the urge to defecate ($p > 0.05$).

The form of sodium bicarbonate supplementation influences the severity of selected gastrointestinal symptoms. The second condition was associated with an increase in nausea after exercise, whereas the first condition was associated with greater symptom severity before exercise. These findings indicate a complex gastrointestinal response to supplementation and highlight the need for individualized supplementation strategies.

Notably, the results presented in this abstract are currently blinded due to ongoing data analysis to ensure objectivity.

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Award: Yes as Young Researcher (under 35 years)

Abstract 29

ANALYSIS OF RULE ADAPTATION IN YOUTH FUTSAL: PERSPECTIVES FROM COACHES AND EXPERTS

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Competition serves as a fundamental educational tool in the development of young athletes. However, competitive structures often fail to align with the psycho-evolutionary needs of children. While other sports like basketball and tennis have explored rule scaling to enhance developmental outcomes, futsal lacks a robust body of scientific evidence regarding the opinions of key stakeholders on potential regulatory modifications. The aim of this study was to analyze the perceptions and levels of agreement among futsal coaches and experts regarding rule modifications in the U-8, U-10, U-12, and U-14 levels to improve the formative process.

A cross-sectional survey design was employed, involving 84 participants (72 coaches and 12 experts). Participants completed a structured questionnaire adapted from validated models in youth basketball. The survey assessed three primary dimensions: a) match structure and player participation (0–10 scale); b) specific U-8 and U-10 rule changes (0–10 scale); and c) categorical rule modifications involving gameplay, equipment, and penalties (0–5 scale). Data were analyzed using mean scores, standard deviations, and t-tests for independent samples to compare opinions between coaches and experts ($p < 0.05$).

Participants favored progressive match durations and emphasized the importance of guaranteed participation for all players in U-8 and U-10 levels (5.3 ± 1.77 ; 5.19 ± 1.63 periods). A strong consensus was reached regarding equipment modification, specifically reducing goal height to 3 m x 1.70 m for the youngest levels (7.96 ± 3.01). Regarding penalties, there was high support for allowing a team to immediately replace a sent-off player if a goal is conceded during the 2-minute penalty (3.94 ± 1.07). Conversely, modifications such as penalizing headers or adding an extra player when trailing by three goals were viewed negatively. Significant differences were noted between coaches and experts regarding the number of fouls required for double penalties in U-14 ($p = 0.05$) and the use of "fly-goalkeepers" ($p < 0.05$).

Coaches and experts recognize the necessity of adapting futsal rules to the maturation stages of children, particularly concerning goal dimensions and participation equity. However, resistance remains toward rules that significantly alter the traditional nature of the game, such as header restrictions. These findings suggest that sports federations should implement evidence-based regulatory changes that balance the "essence" of futsal with the developmental requirements of youth athletes.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 30

MAINTAINING CONFIDENCE UNDER RESTRICTION: GENERAL AND REGULATORY SELF-EFFICACY DURING RAMADAN IN AN ELITE REFEREE

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Previous studies on Ramadan have mainly focused on athletes' physical performance, nutritional habits, and physiological responses, while psychological aspects have received less attention. According to Bandura's theory (1), self-efficacy represents a central determinant of behavior, motivation, and performance. In this framework, it becomes particularly relevant to distinguish between general perceived self-efficacy and regulatory self-efficacy, especially in sport contexts characterized by challenging conditions such as Ramadan fasting.

The aim of this study was to explore potential differences between general perceived self-efficacy and regulatory self-efficacy in a referee during Ramadan fasting, in order to understand whether the perception of being capable remains stable even under conditions of restriction and altered daily habits.

This study was conducted on an elite male referee, aged 36. Self-efficacy was assessed at two time points: once before Ramadan and once during Ramadan (29th day).

The instrument used to assess regulatory self-efficacy was specifically developed for this study based on Bandura's theoretical framework (1), with the aim of investigating the referee's perceived ability to regulate behavior, emotions, and decision-making during performance.

The results show an overall increase in both dimensions of self-efficacy over time. General self-efficacy showed a slight increase (from 9.00 to 9.15), indicating a stable perception of personal capability even under fasting conditions. Regulatory self-efficacy, however, demonstrated a more pronounced improvement (from 9.46 to 9.69). This pattern suggests that, while the referee consistently perceives himself as capable, the ability to regulate emotions, behaviors, and decisions may even strengthen in response to the constraints imposed by Ramadan.

Ramadan remains an underexplored area, particularly with regard to psychological variables in sport performance. The findings of this study highlight not only the stability of general self-efficacy in challenging conditions but also a potential enhancement of regulatory self-efficacy. This suggests that individuals may maintain a strong sense of capability while simultaneously developing adaptive regulatory strategies during periods of restriction. Future studies should involve larger samples to increase the reliability of the results and provide stronger evidence.

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Award: Yes as Young Researcher (under 35 years)

Abstract 31

MULTIDIMENSIONAL PSYCHOLOGICAL AND RECOVERY RESPONSES TO RAMADAN IN AN ELITE SOCCER REFEREE: A CASE STUDY

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Ramadan intermittent fasting is associated with changes in sleep, nutrition, hydration, and circadian rhythms, which can influence both physical [1] and psychological performance [2] in athletes. Recent evidence suggests that Ramadan may affect fatigue, cognitive performance, mood, and coping behaviors, with outcomes depending on individual adaptation and recovery strategies [3-4]. Most studies focus on athletes [5], while little is known about referees, whose performance relies heavily on cognitive efficiency, emotional regulation, and decision-making under pressure.

To investigate changes in motivation, affect, mood, stress-recovery balance, quality of life, and coping strategies in a 38-year-old soccer elite referee before and after Ramadan. We hypothesized that increased psychophysical load would lead to psychological adaptation, reflected in: (i) improved emotional regulation and coping strategies; (ii) reduced energetic activation; (iii) mood states indicative of activation under load; (iv) reduced stress–recovery balance; and (v) improved psychological quality of life.

A single-case pre-post observational design was adopted. The participant completed BIS/BAS, PANAS, ITAMS, RESTQ-36, WHOQOL-BREF, and COPE-NVI 25 before Ramadan and immediately after Ramadan. Data were analyzed descriptively by comparing pre- and post-Ramadan scores across all psychological domains, focusing on direction and magnitude of changes.

Motivational systems showed reduced behavioral inhibition (BIS: 27 to 24) and increased goal-directed drive (14 to 16), indicating improved emotional regulation and motivation. Positive affect decreased substantially (44 to 34), while negative affect slightly increased (12 to 13), suggesting reduced energetic activation. Mood states revealed increased fatigue (7 to 10), tension (4 to 6), anger (0 to 3), and confusion (0 to 2), with stable vigor (13 to 14), indicating a profile of activation under load. Stress-recovery balance showed increased general stress (7 to 9), interpersonal disturbances (9 to 11), and injury-related complaints (11 to 17), alongside decreased perceived physical fitness (17 to 12). However, general well-being (6 to 8) and self-efficacy (15 to 16) improved. Quality of life improved in the psychological domain (12 to 14), while social (8 to 7) and environmental (27 to 24) domains declined, with physical perception unchanged (19 to 19). Coping strategies improved, with reduced avoidance (33 to 30) and increased positive attitude (37 to 41), while problem-focused coping remained high (42).

Ramadan was associated with enhanced psychological regulation, increased motivation, and more adaptive coping strategies, alongside reduced positive affect, increased fatigue,

and greater perceived physical strain. The participant demonstrated improved resilience and cognitive-emotional efficiency but reduced energetic resources. This pattern reflects effective psychological adaptation under increased psychophysical load, highlighting the importance of recovery and energy management strategies to maintain optimal performance. These findings provide novel insights into a previously unexplored area, namely the effects of Ramadan on a referee. Further research involving larger and longitudinal samples is required to better elucidate the effects of Ramadan and their potential transience.

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Award: No

Abstract 32

AUTONOMIC RECOVERY AND FATIGUE REGULATION DURING PRECISION HIIT IN FIBROMYALGIA: EVIDENCE FROM THE FIBROGENHIIT PROJECT.

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Background: Fatigue is a central clinical feature of fibromyalgia and may interact with autonomic recovery during exercise training [1-4]. The FIBROGENHIIT project provides an integrated framework to examine whether autonomic recovery, baseline clinical status, functional capacity, body composition, training exposure, and environmental context are associated with fatigue regulation during precision high-intensity interval training (HIIT).

Objective: To evaluate multidomain predictors of fatigue improvement after precision high-intensity interval training (HIIT) in patients with fibromyalgia, examining the relative contributions of autonomic recovery, baseline clinical status, functional capacity, body composition, training exposure, environmental context, and HTR2A genotype.

Methods: This exploratory secondary analysis used the FIBROGENHIIT dataset and included participants allocated to the Indoor or Outdoor precision HIIT arms. Participants completed a 12-week precision HIIT programme (3 sessions/week), with exercise intensity individually monitored using the FIBROGENHIIT mobile application and Polar H10 heart-rate sensors, enabling real-time physiological monitoring and algorithm-guided exercise progression. The primary outcome was fatigue improvement, defined as the negative change in Multidimensional Fatigue Symptom Inventory (MFSI) total score from T0 to T1, so that higher values indicated greater fatigue reduction. Normality was assessed using Shapiro-Wilk tests. Paired changes were evaluated using paired t-tests or Wilcoxon signed-rank tests according to distributional assumptions. Univariate associations were examined using Pearson or Spearman correlations. Candidate predictors from demographics, body composition, baseline functional tests, cardiopulmonary exercise testing, Polar-derived autonomic variables, clinical questionnaires, training-session variables, environment, and HTR2A genotype were screened using LASSO regression, followed by a parsimonious multivariable linear model with bootstrap internal validation.

Results: The fatigue-change analysis included 62 participants (95.2% women; age 52.05 ± 10.57 years; body mass index 26.36 ± 4.28 kg/m²). MFSI total fatigue improved from 48.56 ± 20.32 at T0 to 35.73 ± 20.24 at T1 (mean change -12.84 ± 24.15 ; paired t-test $p=0.000093$; Cohen's $d_z=-0.53$). Mean 1-minute heart-rate recovery (HRR1) was not associated with fatigue improvement ($r=0.01$, 95% CI -0.25 to 0.27 , $p=0.924$). The strongest univariate

predictor of fatigue improvement was baseline MFSI total score ($\rho=0.62$, 95% CI 0.44 to 0.75, $p<0.001$). In the LASSO-informed multivariable model ($n=46$, $R^2=0.615$), higher baseline MFSI total remained independently associated with greater fatigue improvement ($B=0.87$, 95% CI 0.34 to 1.39, $p=0.002$), whereas higher baseline GHQ-12 score was associated with smaller fatigue improvement after adjustment ($B=-1.30$, 95% CI -2.39 to -0.20, $p=0.022$). Environmental allocation and HRR1 did not show robust independent associations with fatigue regulation.

Conclusions: During precision HIIT in fibromyalgia, fatigue improvement appears to be driven primarily by baseline fatigue burden and broader psychological distress rather than by session-derived autonomic recovery alone. These exploratory findings suggest that personalized HIIT prescription should integrate fatigue severity and psychosocial status alongside physiological monitoring to optimize symptom regulation.

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Award: Yes as Young Researcher (under 35 years)

Abstract 33

EFFECTS OF RAMADAN FASTING ON YO-YO ENDURANCE TEST LEVEL 2 PERFORMANCE IN AN ELITE SOCCER REFEREE: A CASE STUDY

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Ramadan fasting is a common condition among athletes involved in training and competition. During this period, significant changes occur in sleep-wake patterns, as well as in nutritional intake and hydration status, all of which may affect physiological responses to exercise and overall performance [1, 2]. However, the current literature does not provide a clear consensus on the extent to which Ramadan fasting affects performance capacity [3]. In addition, its impact on this condition on soccer referees – who have unique physical and decision-making demands - has not yet been well investigated.

The aim of this study was to investigate the effects of Ramadan fasting on exercise performance in an elite athlete, specifically during the Yo-Yo Endurance Test Level 2, including the assessment of perceived exertion and heart rate monitoring, and respiratory gas analysis. We hypothesized that during Ramadan fasting would not substantially affect performance in the Yo-Yo Endurance Test Level 2, although perceived exertion might increase.

This case study involved a 38-year-old male referee. The protocol was administered twice, once before Ramadan and once on the last day of Ramadan. The participant performed the Yo-Yo Endurance Test Level 2. Immediately after the test, rating of perceived exertion was assessed using the Borg 6-20 scale. Heart rate was continuously monitored using the Polar Team Pro system, while respiratory parameters exchange was measured using a portable metabolic analyzer (Metamax 3B, Cortex Biophysik GmbH, Germany) and analyzed with dedicated software. Body composition was assessed using anthropometric skinfold measurements.

Total distance covered during the Yo-Yo Endurance Test Level 2 increased from 1560 m pre-Ramadan to 1600 m at the end of Ramadan (from 16.6 to 16.5.1 level), corresponding to the completion of one additional stage. At the same time, ratings of perceived exertion decreased from 18 to 17. Heart rate responses remained stable between conditions, with mean heart rate increasing slightly from 98% HR_{max} before Ramadan to 99% HR_{max} at the end, and maximal values were rising marginally from 104% HR_{max} before Ramadan to 105% HR_{max} at the end. Gas exchange analysis revealed a decrease in $\dot{V}O_2/\text{kg}$ (–3.98%), $\dot{V}E/\dot{V}O_2$ (–3.04%), and $\dot{V}E/\dot{V}CO_2$ (–9.31%), while the respiratory exchange ratio (RER) increased by 7.01%. However, when oxygen uptake was normalized to fat-free mass estimated by skinfold assessment, it showed an increase from 54.6 to 55.9 ml·kg FFM^{–1}·min^{–1} (+2.4%) at the end of Ramadan.

The results indicate that Yo-Yo Endurance Test Level 2 performance was maintained during Ramadan, with only minimal variation in total distance covered. Ratings of perceived

exertion showed a slight reduction, suggesting a lower subjective effort during the fasting period. Heart rate responses remained stable, indicating that Ramadan fasting did not significantly affect the cardiovascular response to the Yo-Yo Endurance Test Level 2, as both heart rate patterns and test duration were preserved. Gas exchange analysis revealed reductions in $\dot{V}O_2/\text{kg}$ (-3.98%), $\dot{V}E/\dot{V}O_2$ (-3.04%), and $\dot{V}E/\dot{V}CO_2$ (-9.31%), while the respiratory exchange ratio (RER) increased by 7.01%, suggesting a greater reliance on carbohydrate metabolism. However, when oxygen uptake was normalized to fat-free mass estimated by skinfold assessment, it increased from 54.6 to 55.9 ml·kg FFM⁻¹·min⁻¹ (+2.4%) at the end of Ramadan. Overall, these findings suggest that Ramadan fasting did not impair the athlete's performance. Nevertheless, further research involving larger samples is needed to better elucidate the underlying mechanisms and their potential impact on performance and well-being.

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Award: Yes as Young Researcher (under 35 years)

Abstract 34

ENHANCING TENNIS SERVE PERFORMANCE THROUGH THE MULTI-ACTION PLAN (MAP): A CASE STUDY ON ATTENTIONAL CONTROL AND PSYCHOPHYSIOLOGICAL REGULATION

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Background: In tennis, serve execution is highly sensitive to fluctuations in attention and emotional control, particularly under pressure [1]. The Multi-Action Plan (MAP) model provides a structured framework to regulate performance by identifying and focusing on individual “core components,” promoting attentional stability and facilitating entry into a clutch (optimal-controlled) state [2,3].

Objective: To evaluate the effectiveness of the MAP model in improving tennis serve performance, with a focus on technical execution (accuracy, speed, consistency) and psychophysiological regulation.

Methods: A 21-year-old male tennis player participated in this case study. Testing was conducted on a standard tennis court, with the service box divided into eight scoring zones of increasing difficulty. The athlete used his own racket and 30 balls. Three cameras recorded performance, while SwingVision software analyzed serve speed, placement, and number of successful executions. Heart rate (HR) was monitored using a Polar chest strap. A serve-specific self-efficacy questionnaire, developed according to Bandura’s guidelines, was administered pre- and post-intervention. Following a standardized warm-up, the athlete performed 15 serves (pre-MAP). A structured interview based on the MAP model was then conducted to identify individual core components of the serve. Subsequently, the athlete performed an additional 15 serves (post-MAP), focusing attention exclusively on these components.

Results: The MAP intervention led to immediate improvements in performance and regulation. Pre-intervention, execution was highly variable, with a 66% failure rate (10/15 zero-score serves), associated with a dysfunctional emphasis on maximal velocity (up to 145.4 km/h). Post-intervention, attentional focus on core components enabled a more stable performance profile. Serve velocity decreased to more controlled submaximal levels (90–125 km/h), while failure rate dropped to 26% (4/15), with a clear increase in accurate and effective serves. Physiological data supported this shift. Pre-MAP, the athlete showed elevated arousal (mean HR: 172 bpm; max: 185 bpm), with significant time spent in the highest intensity zone. Post-MAP, HR decreased (mean: 158 bpm; max: 167 bpm), and time in maximal intensity zones was eliminated, indicating improved autonomic regulation. Self-efficacy scores also increased (pre=6/10; post=6,5/10).

Conclusion: The findings support the MAP model as an effective approach to optimize the speed–accuracy trade-off in tennis serving. By directing attention toward individualized core components, the athlete achieved a more stable and controlled execution, consistent with a clutch (optimal-controlled) performance state [2]. This transition was associated with improved technical outcomes, reduced physiological strain [3], and increased self-efficacy [1]. Although limited to a single case, these results provide a rationale for future studies to investigate the effectiveness of MAP-based interventions across different skill levels and competitive contexts, and to explore their impact on performance consistency under pressure.

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Award: Yes as Young Researcher (under 35 years)

Abstract 35

GDF15 CONCENTRATION IN PHYSICALLY ACTIVE SENIORS AND ITS ASSOCIATION WITH EXERCISE INTERVENTION

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Growth differentiation factor 15 (GDF15) is increasingly recognized as a stress-responsive biomarker associated with aging, inflammation, and cardiovascular risk. While elevated GDF15 levels are associated with adverse health outcomes, the impact of structured physical activity on GDF15 concentrations in older adults remains unclear. Understanding how different forms of exercise influence GDF15 may provide insight into mechanisms underlying healthy aging and cardiovascular risk reduction.

The study included 80 physically independent seniors aged ≥ 65 years. Participants were randomly assigned to three groups: an aerobic training group (AT), a combined strength training group (ST), and a control group (CG). The intervention groups participated in supervised 12-week training programs (3 sessions per week), consisting of moderate-intensity aerobic or resistance exercises, respectively. The control group maintained their usual lifestyle without structured exercise. Blood samples were collected at baseline and at the end of the intervention period. Serum GDF15 concentrations were measured using enzyme-linked immunosorbent assay (ELISA). Statistical analyses were performed to assess within- and between-group differences.

At baseline, no significant differences in GDF15 concentrations were observed between groups. Following the 12-week intervention, both exercise groups demonstrated a reduction in GDF15 levels compared to baseline ($p < 0.05$), with a more pronounced decrease observed in the aerobic training group. Between-group comparisons revealed lower post-intervention GDF15 levels in both training groups compared to controls ($p < 0.05$).

Regular, structured physical activity—particularly aerobic training—may reduce circulating GDF15 levels in older adults. These findings suggest that exercise interventions can favorably modulate biomarkers associated with aging and cardiovascular risk. Incorporating targeted physical activity programs may play a key role in promoting healthy aging and reducing disease risk in the elderly population.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 36

COLE MODEL AS REFINED AND NON-INVASIVE METHOD TO PRODROMAL DIAGNOSIS OF STRUCTURAL DAMAGE INCOMING IN ATHLETES OF ASYMMETRIC ARMS SPORTS.

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Background: In a previous study on healthy subjects [1], we found that upper-arm bioimpedance resistance (RUA) was approximately 4% lower ($P < 0.05$) in the dominant arm than in the non-dominant arm, suggesting increased muscle mass and water-electrolyte content due to greater functional use. Although promising as a non-invasive marker of early structural adaptation, evaluation of the resistive component alone is limited because it does not account for alterations in the capacitive properties of tissues, which reflect cell membrane function. Electrical Impedance Spectroscopy (EIS) combined with the Cole model [2] provides additional parameters related to tissue structure and integrity. Critical frequency (F_c) reflects membrane integrity, as cell capacitive reactance decreases with increasing current frequency and becomes null at F_c ; lower F_c values indicate reduced muscle cell integrity in the dominant arm. Relaxation time (τ) represents the time required for membrane depolarization. In asymmetric sports, chronic overuse may induce fibrosis, increasing tissue resistance and forcing electrical current through longer pathways, thereby prolonging τ and suggesting structural damage. Finally, the Cole dispersion parameter (α) ($0 < \alpha \leq 1$) [3] reflects tissue homogeneity: values approaching 1 indicate homogeneous tissue, whereas lower values suggest heterogeneous structures composed of healthy muscle, fibrotic tissue and thickened connective tissue [4].

Objective: The application of Cole model in a cohort of healthy subjects in order to demonstrate the value of the variables F_c , τ and α for possible applications in athletes with suspected overuse of a dominant arm.

Methods: In 21 healthy subjects (28.4 ± 1.4 years, 63.8 ± 11.8 kg, 167.4 ± 7.5 cm) were measurement Z of both UA using a device for EIS as already explained in [1], in order to obtain the values of F_c , τ and α in each their arms. Means $\pm$ SD among subjects were calculated and were compared both for the two UA by the statistical method of Student's t for paired values, and a $P < 0.05$ was considered statistically significant.

Results: Means $\pm$ SD of all 3 Cole's variables considered respectively for main and auxiliary UA were: $F_c = 5403 \pm 950$ Hz and 5686 ± 882 Hz, ($P = 0.33$); $\tau = 3.01 \pm 0.516E-05$ s and $2.87 \pm 0.441E-05$ s ($P = 0.37$); $\alpha = 0.978 \pm 0.037$ radians and 1.000 ± 0.36 radians ($P = 0.057$).

Conclusion: In not skilled subjects for asymmetric arms sports, the mean values among both UA for F_c and τ did not reach statistical significance but both these variables in main

UA surpassed other arm by about 5%. However, for α the P value for difference among UA (about -3%) approached a statistically significance that could likely have been achieved by increasing the number of subjects tested. These result, however, support the effectiveness of Cole model for verifying, in three different ways, possible prodromes of structural differences in a little and obviously overused arm, i.e. that dominant in not particularly trained subject. This reasonably suggests that applying Cole model to high-ranking athletes who compete in asymmetric arms sports could be a useful and refined diagnostic tool for the early diagnosis of onset of functional and structural damage in main arm.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 37

BIOPSYCHOPHYSIOLOGICAL PREDICTORS OF RESPONSE TO PRECISION HIIT IN FIBROMYALGIA: FINDINGS FROM THE FIBROGENHIIT PROJECT.

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Background: Clinical response to exercise in fibromyalgia is highly heterogeneous. Identifying baseline biopsychophysiological factors associated with clinically meaningful improvement may help optimize precision exercise prescription [1-3].

Objective: To identify baseline biopsychophysiological characteristics associated with clinically meaningful improvement following precision high-intensity interval training (HIIT) and to develop a multidomain profile of treatment responders in patients with fibromyalgia.

Methods: This exploratory secondary analysis included 63 participants with fibromyalgia enrolled in the indoor and outdoor HIIT arms of the FIBROGENHIIT trial (98.4% women; age 52.0 ± 10.5 years; height 157.0 ± 7.0 cm; body mass 63.8 ± 11.6 kg). Participants completed a 12-week precision HIIT programme (3 sessions/week), with exercise intensity individually monitored using the FIBROGENHIIT mobile application and Polar H10 heart-rate sensors, enabling real-time physiological monitoring and algorithm-guided exercise progression. Clinical response was defined as at least 14% improvement in the Revised Fibromyalgia Impact Questionnaire (FIQR), consistent with the published minimal clinically important difference for the original Fibromyalgia Impact Questionnaire (FIQ) [4]. Normality of continuous variables was assessed using the Shapiro-Wilk test. Baseline characteristics of responders and non-responders were compared using Welch t-tests or Mann-Whitney U tests according to distributional assumptions. A parsimonious logistic regression model was fitted to evaluate independent predictors of FIQR responder status.

Results: Twenty-five participants (39.7%) were classified as FIQR responders. Responders showed lower baseline fat mass percentage than non-responders ($35.2 \pm 6.3\%$ vs $38.4 \pm 6.2\%$; Mann-Whitney U, $p=0.021$; rank-biserial $r=-0.36$). Baseline fatigue was higher in responders than non-responders (MFSI total: 54.7 ± 17.2 vs 45.0 ± 20.7), showing a clinically plausible trend (Welch t-test, $p=0.054$; Hedges $g=0.49$). In the adjusted logistic model ($n=56$), baseline fat mass percentage remained associated with responder status (OR=0.91, 95% CI 0.83–1.00, $p=0.047$), whereas baseline fatigue showed a positive but non-significant association (OR=1.02, 95% CI 0.99–1.06, $p=0.132$).

Conclusions: Lower baseline fat mass percentage appears to be associated with clinically meaningful FIQR improvement after precision HIIT in fibromyalgia, while greater baseline fatigue may identify patients with larger potential for perceived clinical benefit. These findings are exploratory and hypothesis-generating, supporting the integration of body composition and patient-reported fatigue in future personalized exercise prescription models.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 38

DECISION MAKING UNDER EXERCISE STRESS DURING RAMADAN FASTING: A CASE STUDY IN FOOTBALL REFEREEING

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Decision-making is a fundamental component of refereeing performance, particularly in fast-paced sports such as football, in which referee must make rapid and accurate judgments under continuous physical and psychological stress [3]. In addition, research on Ramadan intermittent fasting indicates that fasting introduces additional physiological and psychological challenges, including increased fatigue [2] and worsened sleep quality [4]. Importantly, cognitive domains critical for decision-making—such as reaction time—appear particularly sensitive to these changes [1]. In this regard, a study has reported impairments in sport-specific decision-making and slower reaction times during Ramadan [5]. Despite these findings, the combined effects of physical load and Ramadan fasting on referees' decision-making remain largely unexplored. To date, no study has specifically investigated sport-specific decision-making in referees during Ramadan under controlled physiological load. The present case study aimed to investigate the impact of exercise-induced physiological load on sport-specific decision-making performance during Ramadan in an elite football referee. Specifically, we examined whether decision-making accuracy is impaired under steady-state exercise conditions during Ramadan compared to a pre-Ramadan condition, while also assessing potential changes in cardiopulmonary function.

This case study involved an elite 38-year-old male referee tested on two occasions: before Ramadan and on the final day of Ramadan. The experimental protocol combined a cardiopulmonary exercise test (CPET) with a sport-specific decision-making task. First, an incremental treadmill test with breath-by-breath gas analysis was performed to determine peak oxygen uptake ($\text{VO}_{2\text{peak}}$) and ventilatory thresholds (VT1 and VT2). Subsequently, participants performed a constant-load running bout at an intensity corresponding to VT1. Once a physiological steady state was achieved, a video-based decision-making task was administered. The task consisted of simulated match situations requiring immediate verbal decisions, replicating real refereeing demands under physical load. Decision-making performance was assessed through response accuracy (error rate). Concurrent physiological variables (heart rate, running speed, and workload indicators) were recorded throughout the protocol.

$\text{VO}_{2\text{peak}}$ remained stable from pre- to post-Ramadan (4.19 vs $4.36 \text{ L} \cdot \text{min}^{-1}$; $\sim 4\%$ increase), indicating preserved maximal aerobic capacity. However, ventilatory thresholds shifted to lower speeds during Ramadan (VT1: $12 \rightarrow 10 \text{ km} \cdot \text{h}^{-1}$; VT2: $14 \rightarrow 13 \text{ km} \cdot \text{h}^{-1}$), suggesting reduced submaximal exercise efficiency. Under steady-state exercise conditions, decision-making accuracy declined markedly during Ramadan, with error rate increasing from 27.3%

to 45.5%. This impairment occurred despite a reduction in external workload, as indicated by lower average ($13.57 \rightarrow 12.23 \text{ km} \cdot \text{h}^{-1}$) and maximal running speeds ($14.40 \rightarrow 13.28 \text{ km} \cdot \text{h}^{-1}$). Mean heart rate slightly decreased ($165 \rightarrow 162 \text{ bpm}$), while internal load (cardiac load: $4 \rightarrow 5 \text{ AU}$) remained comparable. Distance covered during the task increased ($357 \rightarrow 386 \text{ m}$), likely reflecting pacing adjustments.

These findings suggest that, during Ramadan, exercise-induced physiological load exacerbates impairments in sport-specific decision-making, even when maximal aerobic capacity is preserved. The decline in decision-making accuracy under controlled exercise conditions highlights a greater sensitivity of cognitive performance compared to cardiopulmonary function. Overall, Ramadan fasting appears to alter the interaction between physical exertion and cognitive processing, with practical implications for refereeing performance in match-like conditions. Further research with larger samples is warranted to confirm these preliminary observations and to better isolate the combined effects of fasting and exercise on decision-making.

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Award: No

Abstract 39

IMPACT OF RAMADAN FASTING ON EXPLOSIVE STRENGTH AND REPEATED SPRINT ABILITY IN AN ELITE FOOTBALL REFEREE: A CASE STUDY

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Background: Ramadan fasting is a practice that significantly influences an athlete's lifestyle and daily routine. Several studies have shown altering effects on body composition, a crucial factor in sports for determining training programs [1]; other studies have reported an increase

in muscle fatigue from Before Ramadan (BR) to Post Ramadan (PR) [2]. Existing literature remains limited regarding these topics and is sometimes imprecise concerning the influence of Ramadan fasting on performance, specifically focusing on RSA capacity and explosive strength expression in a professional referee.

Objective: The aim of this study is to analyse whether and how Ramadan practice influences explosive strength performance (30m sprint test) and RSA in a professional football referee. Literature findings are discordant: some studies highlight a decrease in power or an increase in sprint times during Ramadan, while others show improved sprint times following the conclusion of Ramadan [3]. Although we hypothesized a potential decrease in metabolic and cardiac performance from pre- to post-Ramadan, it is possible that times and power generated in both tests may remain stable or even improve.

Methods: This case study involved an elite male referee, aged 38. The protocol was administered twice: once before Ramadan (February 18th) and once during the final phase of Ramadan (March 24th). Two tests were administered: the 30m sprint test and the RSA test, preceded by a baseline measurement to evaluate resting heart rate (HR) and Respiratory Exchange Ratio (RER). The first test assesses explosive strength and power generated through a single sprint, while the second evaluates Repeated Sprint Ability using a protocol of five 30m sprints with 30 seconds of active recovery between each. The instrumentation included Microgate photocells positioned at the start and finish lines to record timing data; cardiac parameters were monitored using a Polar chest strap heart rate monitor, and respiratory parameters were collected via a portable gas analyser (metabolimeter). Given that these parameters are heavily influenced by environmental factors, temperature and weather conditions were also monitored. Both testing sessions were conducted on a natural grass football pitch.

Results: A comparison between Before Ramadan (BR) and Post Ramadan (PR) tests shows a worsening of cardiac performance both at rest and under stress during the 30m sprint and RSA tests (except for the fourth and fifth sprints). Specifically, the heart rate (HR) recorded during PR was higher than during BR, suggesting a decline in cardiovascular efficiency. Baseline and exercise RER (Respiratory Exchange Ratio) also showed a significant increase from BR to PR, rising in both the 30m test and all RSA repetitions. In contrast, the

athlete's timing performance clearly improved: there was a 0.13" improvement in the 30m sprint and an average improvement of 0.086" in the RSA repetitions, with the third sprint being the only instance where the time worsened. When evaluating physiological parameters (HR and RER), the influence of environmental factors must be considered: the first test session was notably warmer (14°C, 73% humidity) compared to the second, colder session (8°C, 77% humidity), which may have influenced the athlete's physiological response.

Conclusions: This study analysed the influence of Ramadan fasting on RSA and explosive strength (30m) performance in an elite athlete. The results show that although the athlete experienced a decline in physiological and metabolic efficiency (HR and RER) when comparing BR and PR tests, he nevertheless succeeded in improving his performance and timing. This indicates the effectiveness of the training regimen maintained during the study period. Despite evident physical variations due to dehydration and body composition, alongside muscular and psychological fatigue, the athlete's performance benefited overall. These data are preliminary, and future research should involve a larger sample size.

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Award: Yes as Young Researcher (under 35 years)

Abstract 40

EFFECTS OF COMMUNITY-BASED STRUCTURED EXERCISE ON FUNCTIONAL CAPACITY IN OLDER WOMEN WITH CHRONIC DISEASES: RESULTS FROM THE “ACTIVE COMMUNITIES” PROJECT IN ASL SULCIS

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Background: Population ageing and physical inactivity are major public health challenges, particularly among older adults with chronic non-communicable diseases, frailty, and reduced functional autonomy. Structured exercise training (SET), prescribed and supervised within community-based healthcare pathways, may improve functional status and quality of life [1]. The “Active Communities” (“Comunità Attive”) program is included in the Sardinian Regional Prevention Plan 2020–2025 and promotes multidisciplinary physical activity interventions in the general and frail population [2]. **Objective:** To assess the effects of a community-based SET program on functional capacity and body composition in women aged >60 years with chronic diseases attending territorial healthcare services within ASL Sulcis. **Objective:** To assess the effects of a community-based SET program on functional capacity and body composition in women aged >60 years with chronic diseases attending territorial healthcare services within ASL Sulcis.

This experimental study included 10 women aged >60 years, selected from an initial cohort of 21 patients enrolled in the Experimental Program for the Promotion and Prescription of Adapted Exercise at the Sports Medicine Unit of Santa Barbara Hospital, Iglesias. Participants had chronic non-communicable diseases and multiple comorbidities. The intervention lasted approximately 4 months overall and included a 3-month structured training macrocycle in the hospital gym. Sessions lasted ~60 minutes and included warm-up, aerobic or mixed endurance exercise, and strength training. Pre- and post-intervention (T0–T1) assessment included sports medicine evaluation, anthropometry, bioelectrical impedance analysis (BIA), and the Senior Fitness Test (SFT) battery [3,4]. Statistical analysis included Shapiro-Wilk testing followed by paired Student’s t-test, with significance set at $p < 0.05$.

All SFT parameters improved significantly. Specifically, 6-Minute Walk Test increased from 502.5 to 528.8 m ($p = 0.012$), Chair Stand from 15.0 to 21.0 repetitions ($p < 0.001$), Arm Curl from 18.0 to 26.5 repetitions ($p < 0.001$), 2-Minute Step Test from 83.5 to 111.5 steps ($p < 0.001$), Chair Sit-and-Reach from -2.0 to 3.8 cm ($p = 0.007$), Back Scratch from 4.0 to 9.0 cm ($p = 0.002$), and 8-Foot Up-and-Go improved from 5.8 to 4.5 seconds ($p < 0.001$). Body weight decreased significantly (69.59 vs 68.37 kg; $p = 0.023$), whereas no significant changes emerged in fat-free mass, total body water, phase angle, fat mass percentage, or fat-free mass percentage.

In older women with chronic diseases, a community-based SET program significantly improved overall functional capacity, with benefits in cardiorespiratory fitness, muscular strength, mobility, flexibility, and balance. Changes in body composition were limited. Despite the small sample size, short intervention duration, and lack of a control group, these findings support the clinical relevance and organizational value of multidisciplinary exercise prescription programs in community healthcare settings.

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Award: No

Abstract 41

PREDICTORS OF EXERCISE PROGRESSION IN FIBROMYALGIA PATIENTS UNDERGOING PRECISION HIIT: INSIGHTS FROM THE FIBROGENHIIT PROJECT

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Background: Precision exercise prescription in fibromyalgia requires the identification of patients who are more likely to tolerate and progress within structured HIIT programmes [1-3].

Objective: To identify predictors of exercise progression in participants undergoing the FIBROGENHIIT precision HIIT intervention.

Methods: The analysis included 75 participants with fibromyalgia enrolled in the indoor and outdoor HIIT intervention arms of the FIBROGENHIIT trial (94.7% women; age 51.3 ± 10.8 years; height 156.9 ± 7.2 cm; body mass 65.2 ± 13.5 kg) and 876 protocol-valid training sessions (derived from 991 recorded sessions after protocol-based quality control) recorded during the 12-week intervention period (March and May 2026). The exercise intensity was individually monitored using the FIBROGENHIIT mobile application and Polar H10 heart-rate sensors, enabling real-time physiological monitoring and algorithm-guided exercise progression. The primary outcome was the percentage of valid training sessions classified as “Progress” according to the FIBROGENHIIT progression algorithm. Normality was assessed using Shapiro–Wilk tests. Because the primary outcome was non-normally distributed, univariate associations were examined using Spearman’s rank correlations. Variables demonstrating biological plausibility and/or significant univariate associations, following recommendations for multivariable prognostic model development [4], were entered into a parsimonious multivariable linear regression model with HC3 robust standard errors to identify independent predictors of exercise progression. **Results:** All 75 participants contributed valid progression data. Greater baseline 30-sec chair stand performance was strongly associated with higher progression ($p=0.579$, $p<0.001$), as was baseline 6-minute walk distance ($p=0.507$, $p<0.001$). Adherence showed a smaller but significant association ($p=0.295$, $p=0.009$). In the multivariable model ($n=75$; $R^2=0.353$), baseline 30STS remained the strongest independent predictor of exercise progression ($B=2.95$ percentage points per repetition, 95% confidence interval 1.23 to 4.66, $p<0.001$; standardized $\beta=0.54$), together with adherence ($B=0.27$ percentage points per adherence percentage point, 95% confidence interval 0.04 to 0.50, $p=0.021$; standardized $\beta=0.22$). BMI and training environment were not significant predictors. **Conclusion:** Baseline lower-limb functional capacity and exercise adherence independently predict progression during precision HIIT in individuals with fibromyalgia. These findings support the use of simple functional

assessments to personalize exercise prescription and optimize progression strategies in fibromyalgia rehabilitation programmes.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 42

MICROBIAL COMMUNITIES ACROSS SPORTS SURFACES: EXPLORING THE BIOLOGY OF ATHLETIC ENVIRONMENTS

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Background: Athletic environments, ranging from synthetic turf and indoor courts to gym mats, are unique ecological niches. These surfaces are frequently exposed to human skin contact, perspiration, and environmental debris, creating complex "built environment" microbiomes [1]. Understanding the composition of these microbial communities is crucial, as they can serve as reservoirs for both beneficial commensals and opportunistic pathogens, directly impacting athlete health, infection rates, and surface maintenance protocols.

Objective: The primary aim of this study was to characterize and compare the taxonomic diversity of microbial communities across different sports surfaces. Specifically, we sought to identify how surface material (natural vs. synthetic) and the intensity of human use influence the microbial "fingerprint" of the athletic environment.

Methods: Environmental swabs were collected from four distinct types of surfaces: natural grass pitches, synthetic crumb-rubber turf, PVC-based karate mats, and hardwood squash courts. Samples were taken pre- and post-sport activities. We utilized 16S rRNA gene sequencing to profile bacterial communities and ITS sequencing for fungal identification. Microbial richness and diversity were calculated using Shannon and Simpson indices, while community composition was visualized via Principal Coordinates Analysis (PCoA).

Results: Our findings revealed that surface material is the strongest predictor of microbial composition. Synthetic surfaces (turf and mats) exhibited a lower overall biodiversity but a higher prevalence of human-associated taxa, such as *Staphylococcus* and *Corynebacterium*. Conversely, natural grass pitches displayed high alpha-diversity dominated by soil-dwelling Proteobacteria. Notably, high-contact areas on karate mats showed a significant "microbial shift" toward the skin microbiome after just two hours of training. As was previous notice, it highlighting the rapid transmission of microbes between athletes and their environment [2].

Conclusion: This research demonstrates that sports surfaces are dynamic biological landscapes rather than inert platforms. The dominance of skin-associated bacteria on synthetic surfaces underscores the need for optimized disinfection strategies. These insights provide a scientific baseline for developing antimicrobial materials and hygiene interventions tailored to specific athletic disciplines to mitigate the risk of community-acquired infections.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 43

INDOOR VERSUS OUTDOOR PRECISION HIIT IN FIBROMYALGIA: EFFECTS ON CLINICAL AND FUNCTIONAL OUTCOMES

Meloni M.* ^[1], Fanni M.^[1], Leo P.^[1], Ruggiu M.^[1], Piga M. ^[1], Fois F.^[1], Pazzona R.^[1], Cieszczyk P.^[2], Ghiani G.M.^[2], Carta M.G.^[2], Tocco F.^[2], Massidda M.^[1,2].

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Background: Exercise environment may influence the clinical and functional response to exercise therapy in fibromyalgia [1-4]. The FIBROGENHIIT project compared precision HIIT delivered in indoor versus outdoor settings using an individualized monitoring approach.

Objective: To compare the effects of Indoor versus Outdoor precision high-intensity interval training (HIIT) on clinical and functional outcomes in patients with fibromyalgia.

Methods: This secondary exploratory analysis included 63 participants with fibromyalgia allocated to the active HIIT arms of the FIBROGENHIIT trial (Indoor n=28; Outdoor n=35; 98.4% women; age 52.0 ± 10.5 years; height 157.0 ± 7.0 cm; body mass 63.8 ± 11.6 kg). Participants completed a 12-week precision HIIT programme (3 sessions/week), with exercise intensity individually monitored using the FIBROGENHIIT mobile application and Polar H10 heart-rate sensors, enabling real-time physiological monitoring and algorithm-guided exercise progression. The primary outcome was change in FIQR score from T0 to T1. Secondary outcomes included 30STS, 6MWT, GHQ-12, PSQI, MFSI, and PHQ-15. Normality was assessed using Shapiro-Wilk tests. Within-group changes were analyzed using paired t-tests or Wilcoxon signed-rank tests, and between-group differences in change scores were analyzed using Welch t-tests or Mann-Whitney U tests, according to distributional assumptions. A baseline-adjusted linear model with HC3 robust standard errors was fitted for the primary outcome.

Results: FIQR improved significantly in both groups (Indoor: $\Delta = -6.9 \pm 13.2$, $p = 0.010$, Cohen $d = -0.52$; Outdoor: $\Delta = -9.9 \pm 16.2$, $p = 0.001$, matched rank-biserial $r = -0.65$). The between-group difference in FIQR change was not significant ($p = 0.633$, rank-biserial $r = 0.07$), and remained non-significant after baseline adjustment ($B = 3.05$, 95% CI -4.25 to 10.34 , $p = 0.413$). Outdoor HIIT showed significant within-group improvements in 30STS ($p = 0.013$) and fatigue (MFSI, $p = 0.000$), although between-group differences for these secondary outcomes were not statistically significant.

Conclusions: Both indoor and outdoor precision HIIT were associated with clinically meaningful improvement in fibromyalgia impact, with no robust evidence of superiority of one environment over the other for FIQR change. Outdoor HIIT showed promising exploratory signals for functional and fatigue-related improvements, supporting further investigation of exercise environment as a potential modifier of rehabilitation response in fibromyalgia.

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Funding: This work was supported by Fondazione di Sardegna (Ricaltro_CTC_FDS_2023_P.I. Prof. Myosotis Massidda).

Award: Yes as Senior Researcher (over 35 years)

Abstract 44

EFFECTS OF RAMADAN FASTING ON MAXIMAL AND SUBMAXIMAL AEROBIC PERFORMANCE IN AN ELITE FOOTBALL REFEREE: A CASE STUDY USING CARDIOPULMONARY EXERCISE TESTING

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Background: Ramadan is characterized by daytime fasting, leading to significant alterations in nutritional intake, hydration status, and sleep–wake cycles, all of which may impact physical performance. Within the field of exercise physiology, the cardiopulmonary exercise test (CPET) is widely regarded as the gold standard for the comprehensive assessment of integrative cardiovascular, respiratory, and metabolic responses to incremental exercise. CPET provides an objective and reproducible opportunity to quantify limitations in exercise capacity [1]. Among CPET-derived variables, the first ventilatory threshold (VT1) represents a key marker of aerobic capacity and metabolic efficiency. Accordingly, the longitudinal assessment of performance and VT1 through CPET during Ramadan provides a valuable framework to elucidate the physiological impact of fasting and to inform evidence-based training strategies during this period. To date, the available literature has primarily focused on soccer players [2,3], whereas investigations involving elite referees remain notably absent.

Objective: The aim of the present study was to investigate differences in peak oxygen uptake ($\text{VO}_{2\text{peak}}$) and the first ventilatory threshold (VT1) between pre- and post-Ramadan conditions. Based on previous studies, it is hypothesized that $\text{VO}_{2\text{peak}}$ will not exhibit substantial changes following Ramadan fasting [4–6].

Methods: This case study involved an elite male referee aged 38 years. The protocol was administered twice: once before Ramadan and once on the last day of Ramadan. The referee underwent a standard cardiopulmonary exercise test on a treadmill to assess physical capacity. Respiratory parameters were measured using a gas analyser, and dedicated software was used to evaluate $\text{VO}_{2\text{peak}}$ and VT1. The test was conducted to volitional exhaustion using a MetaMax 3B breath-by-breath metabolic system (CORTEX Biophysik GmbH, Leipzig, Germany). Following a 3-minute standardized warm-up, the referee performed an incremental protocol starting at 8 km/h with a constant 1% gradient, increasing by 1 km/h every minute until exhaustion. To ensure standardized experimental conditions, testing was performed in a controlled laboratory environment, with the room sealed and under constant artificial lighting to minimize environmental fluctuations.

Results: The results show that $\text{VO}_{2\text{peak}}$ remained substantially unchanged between pre- and post-Ramadan conditions (4.19 vs 4.36 L/min, ~4% increase), in line with previous literature reporting stability of maximal aerobic capacity during Ramadan fasting [4–6]. This variation falls within typical CPET test–retest variability (2–5%), suggesting no true change in maximal performance; therefore, maximal aerobic capacity can be considered preserved.

In contrast, both ventilatory thresholds showed a downward shift following Ramadan fasting. VT1 decreased from 12 to 10 km/h, while VT2 decreased from 14 to 13 km/h.

Conclusion: In conclusion, this case study suggests that Ramadan fasting does not appear to substantially affect maximal aerobic capacity, as $\text{VO}_{2\text{peak}}$ remained stable between pre- and post-Ramadan conditions. This stability supports preservation of maximal physiological performance. In contrast, both ventilatory thresholds showed a downward shift following Ramadan fasting. This pattern may indicate an earlier onset of ventilatory compensation during incremental exercise and reduced submaximal exercise tolerance. It may also reflect reduced metabolic efficiency at moderate intensities or a shift in substrate utilization. Notably, while $\text{VO}_{2\text{peak}}$ remained unchanged, the reduction in ventilatory thresholds suggests a dissociation between maximal and submaximal physiological responses. Due to the single-subject design, results cannot be generalized but nevertheless provide preliminary insights and underscore the need for further research involving larger cohorts of elite referees.

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Award: Yes as Young Researcher (under 35 years)

Abstract 44

EFFECTS OF RAMADAN FASTING ON SLEEP DURATION AND RECOVERY IN A COMPETITIVE REFEREE: A CASE STUDY

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Background: Studies have reported negative effects of Ramadan fasting on physical performance, mood, body composition, and dietary habits [1]. However, evidence regarding its impact on cognitive function in athletes remains limited and inconsistent. Changes in meal timing, nutrient intake, and hydration status during Ramadan may also influence sleep patterns and recovery. Some findings suggest that maintaining regular training routines and daily habits may help mitigate performance declines [2].

Objective: To analyze the effects of Ramadan fasting on sleep duration in an athlete, comparing pre-Ramadan, during Ramadan, and post-Ramadan periods. We hypothesized that during Ramadan the athlete would experience a reduction in sleep duration, accompanied by a potential decline in sleep quality [3].

Methods: This case study involved a 38-year-old male referee. Sleep data were collected across three distinct periods: one week prior to the start of Ramadan (Baseline), the entire month of Ramadan, and one month post-Ramadan. Sleep parameters were monitored using a Garmin Forerunner 745 device. The athlete recorded and submitted the data daily for analysis. The primary outcome was sleep duration, also considered in relation to sleep score. Secondary variables included sleep quality indicators, heart rate, respiratory rate (brpm), and nocturnal restlessness.

Results: The results indicate a reduction in sleep duration during Ramadan (6 h 55 min, -12.3%) compared with baseline (7h53'), followed by a partial recovery in the post-Ramadan period (7h14', -8.2% vs baseline); however, sleep duration did not return to initial baseline values. Pre-competition nights showed a consistent decrease in sleep duration across all observed periods (Pre-Ramadan: 5h36'; Ramadan: 6h52'; Post-Ramadan: 7h12'). Post-competition nights, particularly during Ramadan (4h23', -45.8%) and post-Ramadan (3h22', -58.3%), exhibited a pronounced reduction in total sleep time compared to baseline (8h05'). No significant differences were observed in secondary variables, including mean heart rate, mean respiratory rate, and nocturnal restlessness levels.

Conclusion: Ramadan fasting significantly affects sleep patterns in this athlete, primarily by reducing total sleep duration. This reduction is largely driven by nocturnal awakenings for the pre-dawn meal [4]. The combined effects of fasting and competition stress resulted in substantial sleep deficits, especially following matches. Although physiological markers remained stable, reduced sleep may negatively impact recovery and overall well-being [5]. These findings highlight the importance of tailored sleep hygiene strategies for athletes and referees during Ramadan [2, 3]. Future research should evaluate the effectiveness of sleep hygiene interventions and post-match sleep management strategies (e.g., controlled light

exposure, optimized recovery routines, and strategic napping) to mitigate sleep deficits during Ramadan.

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Award: Yes as Young Researcher (under 35 years)

Abstract 45

EFFECTS OF RAMADAN FASTING ON SLEEP DURATION AND RECOVERY IN A COMPETITIVE REFEREE: A CASE STUDY

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"Physical inactivity is a silent killer causing 3.2 to 5 million deaths globally each year, with an estimated 1.8 billion adults failing to reach the physical activity guidelines, underscoring the persistent gap between recommended and actual activity levels. Conventional exercise interventions such as structured aerobic, resistance or balance training, often face substantial adherence challenges with session attendance frequently falling below 60% and dropout rates reaching up to 35%. In response to these limitations, public health authorities have increasingly advocated for innovative and engaging exercise modalities capable of enhancing long term participation. Recreational team sports have emerged as a promising alternative, fostering higher intrinsic motivation, superior adherence, and lower attrition compared with individual exercise formats such as cycling or resistance training. Furthermore, recreational team sports have demonstrated multidimensional health benefits making them highly relevant for different populations.

Within this context, walking-based team sports have emerged as an accessible, less demanding version for those with physical or health limitations that may not be able to cope with recreational team sports demands.

This presentation will focus on current evidence on the activity profile, physiological load and perceived experience of walking team sports and on its potential to elicit improvements in health and fitness outcomes, namely in clinical populations or otherwise vulnerable populations.

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Award: No

Abstract 46

ADVANCING ATHLETE DIAGNOSTICS IN BADMINTON: A NEUROMECHANICAL PERSPECTIVE

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Modern athlete diagnostics are evolving from traditional outcome-based measures toward integrated neuromechanical approaches. In sports such as badminton, characterized by rapid and high-intensity movements, performance depends not only on mechanical output but also on neuromuscular control. Traditional indicators, such as jump height, may not fully capture subtle deficits in movement coordination and force generation. The aim of this study was to evaluate neuromechanical indicators based on existing evidence and the author's own research, and to demonstrate their integrated application in badminton athlete diagnostics.

A structured analysis of selected studies focusing on reactive strength index (RSI), force-time characteristics (including impulse and rate of force development), and electromyographic (EMG) parameters was conducted. The data were derived from the analysis of previously published studies as well as the author's own research [1]. The author's study included elite badminton players and assessed neuromechanical adaptations to EMG-guided stretch-shortening cycle training. Evidence from different sports disciplines was included to identify common neuromuscular determinants of performance. The selected variables were analyzed in terms of their applicability in athlete diagnostics, with particular emphasis on their integration within a multidimensional neuromechanical framework.

RSI was identified as an indicator of stretch-shortening cycle efficiency and dynamic performance [2]. Force-time characteristics were associated with the ability to effectively generate force during dynamic tasks [4]. EMG-based analyses demonstrated the role of neuromuscular activation patterns in shaping movement performance and training adaptations [1]. Additionally, asymmetry and force efficiency indices were shown to influence movement effectiveness in badminton players [3]. The integration of these parameters enables more precise detection of functional deficits compared to traditional performance metrics alone.

A multidimensional neuromechanical approach may enhance athlete diagnostics in badminton. The combined assessment of RSI, force-time characteristics, and EMG parameters provides a more comprehensive evaluation of neuromuscular performance and may support targeted training and injury prevention strategies.

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Award: Yes as Young Researcher (under 35 years)

Abstract 47

CARDIORESPIRATORY FITNESS PARAMETERS IN PATIENTS WITH FIBROMYALGIA: PRE-EVALUATION BEFORE HIIT PRESCRIPTION

Ruggiu M.^[1], Porceddu M.^[2], Bellomi G.^[2], Manai M.^[2], Fanni M.^[1], Meloni M.^[1], Pallazzoni M.^[3], Ghiani G.M.^[1], Massidda M.^[1], Tocco F.^[1]

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Fibromyalgia (FM) is a chronic rheumatic condition characterized by widespread musculoskeletal pain and other symptoms such as fatigue, unrefreshing sleep, cognitive problems, mood issues, and sensitivity to touch, light, noise, or temperature. [1]

In Italy approximately 2 million patients are affected by fibromyalgia, ranking third among the rheumatologic disease. [2]

FM is treated through both pharmacological and non-pharmacological means. [3]

Among the latter physical exercise is considered an approach to the FM treatment. [4]

In fact, there is an empirical evidence that exercise reduces the symptoms of most musculoskeletal pathologies, including FM. [5]

Different types of exercise (i.e., aerobic, resistance, stretching, HIIT) contribute positively to the quality of life of subjects with FM, enhancing the reduction of pain and depression [6].

The aim was to assess the cardiorespiratory fitness parameters before the HIIT prescription. The patients analysed were part of the research study "FIBROGENHIIT", a randomized controlled clinical trial developed at the Department of Medical Sciences and Public Health, University of Cagliari.

The cardiorespiratory fitness parameters were assessed with a cycle ergometer cardiopulmonary exercise test. We used an incremental protocol (ramp protocol) personalized and symptom-limited, adapted to FM patients to reduce musculoskeletal discomfort, the risk of early test interruption and achieve the maximum individual effort, in a time between 8 and 12 minutes.

The protocol included 4 steps: rest (3 minutes), warm-up (3 minutes), incremental workload (10 W per minute) and cool down (3-5 minutes).

During the test heart rate, blood pressure and oxygen saturation were measured.

At peak effort, we assessed the RPE 1-10 Borg scale (Rate of Perceived Exertion).

All tests were stopped at the participant's request or upon reaching clinical safety criteria, in agreement with recommendations for clinical populations. [7]

We analysed 55 patients affected by fibromyalgia (52 females and 3 males). The mean age was 49.8 ± 10.6 years, and the mean body mass index was 26.09 ± 4.8 kg/m².

The mean $\dot{V}O_2$ peak was 18.6 ± 4.54 ml·kg⁻¹·min⁻¹, corresponding to 1.167 ± 0.209 L·min⁻¹.

The mean $\dot{V}O_2$ at VT1 $75.1\% \pm 9.8$, $\dot{V}O_2$ at Fat max 58.7 ± 8.89 .

The mean maximal power output (W_{max}) was 71.6 ± 26.3 W, the mean power at VT1 was 48.56 ± 18.3 W, and the mean power at Fatmax was 30.5 ± 11.3 .

The mean maximal heart rate was 145 ± 22 bpm, and the mean pulse O₂ 8.04 ± 1.633 ml/beat.

The mean ventilation max was 44.4 l/min ± 13.4 l/min, the mean ventilation VT1 was 28.6 ± 7.72 . The mean RPE Borg Scale was 8.2 ± 1.5 .

The most frequently reported symptom was lower limb pain, observed in 48 out of 55 (87%). Less frequent symptoms included dyspnea, upper limb pain, and knee pain. A small number of patients reported combined symptoms such as lower limb pain associated with dyspnea, vertigo, or gluteal pain.

Patients with fibromyalgia showed reduced cardiorespiratory fitness, compared to the healthy population of the same age, as indicated by low VO₂ peak values and limited maximal power output.

The early occurrence of VT1 and Fatmax at relatively low exercise intensities suggests impaired aerobic efficiency and early fatigue.

Exercise limitation was predominantly associated with musculoskeletal pain, particularly in the lower limbs, rather than cardiorespiratory constraints.

These findings highlight the importance of individualized exercise prescription, supporting the use of tailored HIIT protocols adapted to patients' tolerance and level of training. Pre-participation CPET assessment appears essential to optimize safety and effectiveness of exercise interventions in this population.

These results provide a strong physiological rationale for HIIT prescription in FM and support its use as a targeted, evidence-based therapeutic strategy.

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Funding: This work was supported by Fondazione di Sardegna (Ricaltro_CTC_FDS_2023_P.I. Prof. Myosotis Massidda).

Award: Yes as Young Researcher (under 35 years)

Abstract 48

FEASIBILITY AND PRELIMINARY EFFECTS OF IMMERSIVE VIRTUAL REALITY COGNITIVE TRAINING IN OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT: A RANDOMIZED CONTROLLED TRIAL

Sancassiani F.^[1], Perra A.^[1], Vacca V.^[1], Monni M.^[2], Corrias A.^[2], Lorrai S.^[1], Arippa F.^[3], Lorrai G.^[1], Carta D.^[1], Ardu M.^[1], Muscas F.^[4], Muggianu F.^[4], Pau M.^[3], Montisci R.^[1], Redolfi S.^[1], Petretto D.^[4], Scuteri A.^[1], Machado S.^[5], Nardi A.E.^[5], Carta M.G.^[1]

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Award: Yes as Young Researcher (under 35 years)

Abstract 49

FUNCTIONAL PERFORMANCE ADAPTATIONS TO PRECISION HIIT IN FIBROMYALGIA: FINDINGS FROM THE FIBROGENHIIT PROJECT

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Background: Fibromyalgia is commonly associated with impaired physical function, reduced exercise tolerance, and low confidence in movement [1-4]. Within the FIBROGENHIIT project, a precision high-intensity interval training intervention was implemented to evaluate whether individualized exercise prescription can improve functional performance in patients with fibromyalgia.

Methods: This exploratory longitudinal analysis included 95 participants allocated to the exercise arms of the FIBROGENHIIT study and with at least one paired functional outcome available. Mean age was 50.64 ± 10.48 years and 96.7% were women. Functional outcomes were assessed before and after the intervention using the six-minute walk test, 30-second sit-to-stand test, back-scratch test, and sit-and-reach test [4]. Normality of change scores was assessed using the Shapiro-Wilk test. Paired-samples t-tests or Wilcoxon signed-rank tests were selected according to distributional assumptions. Associations with Fibromyalgia Impact Questionnaire-Revised response were explored using Mann-Whitney U tests and Spearman correlations.

Results: The 30-second sit-to-stand test improved significantly from T0 to T1 ($n=49$; delta 3.45 ± 7.37 ; Paired-samples t-test, $p=0.002$; Cohen's $d_z=0.47$). Six-minute walk distance showed a numerical but not statistically robust improvement ($n=45$; delta 25.11 ± 125.24 ; $p=0.186$). Flexibility-related outcomes showed variable responses, with back-scratch performance showing the clearest signal (right side: $p=0.006$; left side: $p<0.001$). Exploratory responder analyses suggested that functional gains and clinical improvement were not uniformly coupled across all outcomes.

Conclusions: Precision high-intensity interval training was associated with a clinically relevant improvement in lower-limb functional performance in patients with fibromyalgia, particularly for the 30-second sit-to-stand test. These findings support the inclusion of simple field-based functional tests as translational outcomes in personalized exercise medicine, while larger confirmatory analyses are needed to clarify their relationship with symptom-based clinical response.

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Award: Yes as Young Researcher (under 35 years)

Abstract 50

STABILITY OF ARTERIAL OCCLUSION PRESSURE ACROSS THE MENSTRUAL CYCLE: IMPLICATIONS FOR BLOOD FLOW RESTRICTION TRAINING PRESCRIPTION

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The individualization of blood flow restriction (BFR) training is contingent upon arterial occlusion pressure (AOP), which defines the external pressure applied to the limb. AOP is typically measured once and used consistently across multiple training sessions. However, rather than a static value, AOP reflects a dynamic interplay between systemic blood pressure and local vascular characteristics. The extent to which short-term physiological fluctuations, such as those occurring during the menstrual cycle (MC), may significantly influence AOP remains uncertain.

The MC represents a recurring physiological process characterized by complex, phase-dependent changes in cardiovascular regulation. Fluctuations in autonomic nervous system activity, vascular compliance, and endothelial function have been reported across menstrual cycle phases, potentially influencing peripheral blood flow and pressure-related measures [1]. Additionally, differences in sympathetic activity between early follicular and luteal phases may affect blood pressure and vascular resistance [2]. Despite these observations, their practical implications remain unclear, particularly whether such fluctuations affect AOP, which depends on systemic blood pressure and local vascular properties. Previous studies have primarily focused on performance outcomes or hormonal profiles [3], with limited attention to pressure-based measures relevant to BFR prescription. Given that current BFR guidelines emphasize individualized pressure calibration [4], understanding whether AOP remains stable or varies across the MC is of both theoretical and practical importance. Therefore, the aim of this study was to evaluate changes in AOP across different phases of the menstrual cycle in physically active women, taking into account individualized cycle length and standardized measurement conditions.

Fourteen physically active women (age 20.8 ± 1.19 years; body mass 66.71 ± 9.92 kg; height 170.36 ± 6.04 cm) with regular MC, not using hormonal contraception for at least six months, participated in the study. AOP was measured at four time points across a single MC, with measurement days individualized based on cycle length (short: 24–26, medium: 27–29, long: 30–32 days), adapted from population-based distributions. Measurements were performed on day 2 (early follicular phase), days 6–9, days 11–18 (ovulatory phase), and days 18–24 (mid-luteal phase). All procedures were conducted under standardized laboratory conditions. Participants refrained from intense physical activity, caffeine, and alcohol for 24 hours prior to testing. Upon arrival at the laboratory, participants rested in a supine position for 15 minutes, after which AOP was assessed in one lower limb, followed by a 10-minute rest and measurement in the contralateral limb. To assess AOP, pressure cuff (Fit Cuffs, Denmark; 10 cm width) was applied to the most proximal part of the thigh. The study was approved by the local Bioethics Committee (no. 3, 13.03.2024).

A repeated-measures two-way ANOVA revealed a significant main effect of menstrual cycle phase ($p = < 0.001$; $\eta^2 = 0.450$) on AOP. Post-hoc pairwise comparisons demonstrated that AOP values in the early follicular phase (measurement 1) were significantly higher compared to the subsequent measurement points, including measurement 2 ($p = .030$), measurement 3 ($p = .001$), and measurement 4 ($p = .018$). In contrast, no significant differences were observed between later phases of the MC, as indicated by non-significant comparisons between measurement 2 and 3 ($p = .357$), measurement 2 and 4 ($p = .274$), and measurement 3 and 4 ($p = 1.000$). Furthermore, there was no significant interaction effect (set $\times$ limb) as well as no main effect of limb.

The present study demonstrates that AOP changes across the MC in physically active women. AOP was significantly higher in the early follicular phase compared to subsequent phases, with values stabilizing thereafter, indicating phase-dependent modulation of vascular conditions. These findings have practical implications for BFR prescription, highlighting the need for phase-specific AOP assessment rather than reliance on a single baseline measurement. Failure to account for menstrual cycle-related variability may result in inappropriate pressure application and suboptimal training stimulus.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 51

DOES ONE SIZE FIT ALL? HOW MODIFIED RULES SHIFT THE PLYOMETRIC LANDSCAPE IN YOUTH BASKETBALL

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Optimal development in youth basketball requires adapting competition contexts to the physical and biological capabilities of athletes [1]. During pre-adolescence, variability in neuromuscular maturation significantly influences plyometric performance, which is crucial for actions such as jumping, rebounding, and sprinting [2,3]. While training programs have been extensively studied, there is limited evidence on how modified competition formats affect natural physical loads and whether maturational status moderates this impact [4,5]. The aim of this study was to analyze the effects of two competition formats (standard vs. modified) on the plyometric performance of U13 basketball players, evaluating the moderating role of maturational age.

Thirty-seven male U13 players (12.91 ± 0.57 years) participated in two tournaments under a repeated-measures design. The Standard Tournament followed official rules. The Modified Tournament (MT) reduced the rim height to 2.90 m and replaced the three-point line with a 4 m rectangle. Plyometric variables (impacts, steps, jumps, and G-forces) were monitored using GPS/LPS devices (WIMU PRO, 1000 Hz). Maturation was estimated via the percentage of predicted adult height (%PAH) using the Khamis-Roche method. Analysis included t-tests, Bayes Factors (BF10), and moderation analysis using the Johnson-Neyman technique.

MT significantly increased playing time ($p=0.008$; $BF_{10}=5.06$) and the number of steps ($p=0.013$; $BF_{10}=3.46$) during positional offense phase. Significant differences with moderate evidence were found in 5-8 G landings ($p=0.008$; $BF_{10}=5.06$) and >8 G take-offs ($p=0.006$; $BF_{10}=6.27$) during offense. In fast breaks, MT generated a higher number of 3-5 G horizontal impacts ($p=0.002$; $BF_{10}=18.41$) with strong evidence. Biological maturation acted as a consistent moderator: the effect of MT on playing time was significant only for players above the 88.22% PAH threshold. Regarding total impacts during set-play offense, the effect was significant within the 88.99% to 94.68% PAH range. In fast breaks, the increase in horizontal impacts was significant for players exceeding 89.05% PAH.

Modified rules significantly alter plyometric demands, fostering a higher frequency of high-intensity actions (>8 G). However, this stimulus is not uniform, as biological maturation moderates the response to rule changes. Coaches should consider that regulatory modifications predominantly benefit players with more advanced maturational development in this category, suggesting the need for additional adjustments to ensure equitable development across different maturation levels.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 52

YOGA TRAINING FOR BETTER STRESS REGULATION IN UNIVERSITY STUDENTS

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Effective stress regulation is essential for sustaining both academic functioning and performance related psychological resilience in young adults. University students frequently experience elevated stress loads, which can impair cognitive efficiency, recovery capacity, and overall well being. Yoga, as a mind–body training method, has gained attention for its potential to modulate psychophysiological stress responses. This study examines how regular yoga training influences stress regulation in university students.

A 13 week controlled intervention was conducted with 86 participants in a structured yoga training program and 64 students serving as controls. Pre and post intervention assessments included standardized measures of trait and state anxiety, perceived stress, and mood related indicators. The yoga protocol integrated postural sequences, breathing regulation, and guided relaxation techniques aimed at improving autonomic balance and stress resilience.

Students participating in regular yoga training demonstrated significant reductions in trait anxiety and perceived stress compared to the control group, alongside improvements in emotional stability. These psychophysiological adaptations suggest enhanced stress regulation capacity, which is relevant for academic and sport related performance contexts.

Regular yoga training is an effective, low cost intervention that improves stress regulation and mental resilience in university students. The findings support its inclusion in Exercise as Medicine and Sport Performance frameworks and highlight its potential role in performance optimization and student well being programs.

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Award: Yes as Senior Researcher (over 35 years)

Abstract 53

ADDING BLOOD FLOW RESTRICTION TO SYSTEMIC HYPOXIA TRAINING AT 3500 M ENHANCES STRENGTH, NEUROMUSCULAR PERFORMANCE, MUSCLE MECHANICAL PROPERTIES, AND ANTIOXIDANT MARKERS

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Systemic hypoxia and blood flow restriction (BFR) are used to enhance neuromuscular adaptations by increasing metabolic stress and motor unit recruitment [2,4]. Resistance training under hypoxic conditions has been shown to improve strength and muscle hypertrophy [3], while BFR can induce similar adaptations even at lower mechanical loads [4]. The combination of systemic and local hypoxia may further augment physiological stress and neuromuscular responses [5,6]. However, the effectiveness of this combined approach during high-load resistance training remains unclear. Therefore, the aim of this study was to determine whether adding BFR to resistance training performed under systemic hypoxia (simulated altitude 3500 m) induces greater improvements in maximal strength, neuromuscular performance, muscle morphology, and antioxidant markers compared with hypoxic training alone.

Thirty-four recreationally trained participants were randomly assigned to hypoxic resistance training (H) or hypoxic training with BFR (H+BFR). Both groups performed bilateral leg press at 80% one-repetition maximum (1RM) using a 30/15/15/15 repetition scheme, twice weekly for 6 weeks in a normobaric hypoxic chamber (3500 m). The H+BFR group trained with cuffs set at 80% arterial occlusion pressure, in line with current methodological recommendations [4]. Assessments included 1RM, countermovement jump (CMJ), muscle thickness, body composition, hemoglobin (Hb), hematocrit (HCT), and antioxidant enzymes (SOD, CAT). Measurements were conducted before and after the intervention, with additional acute pre- and post-session testing.

A significant effect of time was observed for maximal strength (1RM) ($p < 0.001$), with increases of $+11.2 \pm 10$ kg (H) and $+14.3 \pm 22.1$ kg (H+BFR). Muscle thickness increased significantly ($p < 0.001$) by $+1.3 \pm 1.1$ mm (H) and $+1.2 \pm 1.1$ mm (H+BFR), while body fat percentage decreased ($p = 0.016$). No significant group or interaction effects were found ($p \geq 0.436$). CMJ height (-1.73 ± 3.9 cm) and peak power (-1.9 ± 4.6 W $\cdot$ kg $^{-1}$) decreased acutely post-exercise ($p = 0.006$), with no between-group differences. Hb ($+0.81 \pm 1.14$ g/dL; $+0.84 \pm 1.11$ g/dL) and HCT ($+1.19 \pm 1.17\%$; $+1.89 \pm 2.75\%$) increased significantly ($p \leq 0.010$), whereas SOD and CAT showed no changes ($p \geq 0.153$). No group differences were observed in hematological variables.

Six weeks of resistance training under systemic hypoxia improved maximal strength, muscle morphology, body composition, and hematological parameters. However, the addition of BFR did not provide additional benefits. These findings suggest that systemic hypoxia alone

is a sufficient stimulus to induce neuromuscular and hematological adaptations during high-load resistance training.

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Award: Yes as Young Researcher (under 35 years)

Abstract 54

EFFECTIVENESS OF A MOTOR EXERCISE PROTOCOL ON GLENOHUMERAL MOBILITY AND UPPER LIMB STRENGTH

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Background: Water polo is a sport characterized by high metabolic demand with an intermittent profile, requiring continuous transitions between anaerobic alactic systems (sprints, shots, physical contacts) and lactic/aerobic systems (functional swimming and vertical treading). Within this context of systemic fatigue, the glenohumeral joint is exposed to extreme biomechanical stress during overhead activities. The combination of the high frequency of throwing actions and the propulsive component of swimming promotes the development of Glenohumeral Internal Rotation Deficit (GIRD), an adaptation that exponentially increases the risk of overuse injuries.

Objective: The aim of this study was to evaluate the effectiveness of a preventive exercise protocol in improving active and passive Range of Motion (ROM) and upper limb muscle strength, as well as to explore the genetic influence on these improvements.

Methods: Forty-six Italian male water polo players competing in the national Serie C championship were divided into an experimental group (n = 22), which underwent a motor exercise protocol, and a control group (n = 24). Assessments were conducted at T0 (start of the season) and T1 (end of the first half of the championship). Active and Passive Range of Motion (AROM and PROM) in internal rotation (IR) and external rotation (ER) were measured using clinical goniometry. Total Range of Motion (TROM) and rotational deficit were calculated. Upper limb strength was assessed using the Handgrip test (Jamar hydraulic dynamometer). Functionality and overuse symptoms were monitored using the Kerlan-Jobe Orthopedic Clinic (KJOC) and Oslo Sports Trauma Research Center Overuse (OSTRC-O) questionnaires. Buccal swabs were collected from all athletes, and DNA was extracted using the salting-out method. Genotyping was performed for ACE I/D, ACTN3 rs1815739, MCT1 rs1049434, and PPARGC1A rs8192678 polymorphisms. Statistical analysis was conducted using JASP (t.test for independent samples) and SNPstats (ODD Ratio).

Results: □ **Active and Passive Mobility:** At T1, the experimental group showed a significant increase in passive internal rotation (PROM IR: T0 = 68.5 ± 10.9 ; T1 = 76.1 ± 11.7 ; p = 0.029) and active internal rotation (AROM IR: T0 = 57.6 ± 11.1 ; T1 = 65.2 ± 12.2 ; p = 0.038). In the control group, improvements were less pronounced and not statistically significant for passive mobility. □ **External Rotation and TROM:** PROM ER remained stable in both groups; however, the experimental group exhibited a more homogeneous improvement in Total ROM (TROM), with a significant reduction in bilateral rotational deficit (p = 0.042). □ **Symptoms and Functionality:** The experimental group maintained minimal OSTRC-O scores, indicating the absence of pain-related limitations. Conversely, the control group

showed a slight increase in overuse symptoms from T0 to T1. The KJOC score was significantly more stable in the prevention group ($p = 0.047$). □ Strength: The control group maintained stable grip strength between T0 (47.85 kg) and T1 (47.05 kg), with a p-value of 0.534 indicating no significant changes over time. The experimental group demonstrated an increase in mean grip strength from T0 (47.82 kg) to T1 (49.05 kg), showing an opposite trend compared to the control group. However, the p-value of 0.115 indicates that this improvement did not reach statistical significance ($p > 0.05$). Although a positive trend was observed, the intervention effect cannot be considered scientifically relevant; the findings suggest that competitive season stress and accumulated fatigue may have limited strength gains. □ Genetic analysis showed that the sample was in Hardy–Weinberg equilibrium. Preliminary results indicated a non-significant trend toward increased strength values associated with the MCT1 genotype, with the T allele appearing to be linked to greater strength expression. Preliminary data suggest that the integration of preventive exercises significantly improves both passive and active shoulder ROM, effectively counteracting posterior capsular stiffness typical of overhead athletes. The maintenance of low OSTRC-O scores confirms that the protocol acts as a protective factor, reducing the clinical impact of seasonal stress and ensuring greater performance continuity.

Award: Yes as Young Researcher (under 35 years)

Abstract 55

WHO BENEFITS MOST FROM PRECISION HIIT? FUNCTIONAL RESPONDER PATTERNS FROM THE FIBROGENHIIT STUDY.

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Background: Fibromyalgia is characterized by heterogeneous functional limitations and variable adaptation to exercise [1–3]. Beyond mean pre-post changes, identifying who functionally benefits from precision high-intensity interval training may support individualized exercise prescription.

Objective: To develop a multidomain functional responder profile following precision high-intensity interval training (HIIT) in patients with fibromyalgia and explore baseline characteristics associated with high functional response.

Methods: This exploratory secondary analysis included 95 participants from the exercise arms of the FIBROGENHIIT study with at least two paired functional domains available. Mean age was 50.64 ± 10.48 years and 96.7% were women. Participants completed a 12-week precision HIIT programme (3 sessions/week), with exercise intensity individually monitored using the FIBROGENHIIT mobile application and Polar H10 heart-rate sensors, enabling real-time physiological monitoring and algorithm-guided exercise progression. A Functional Responder Score was calculated as the percentage of available domains reaching predefined operational improvement thresholds: six-minute walk test ≥ 30 m, 30-second sit-to-stand test ≥ 2 repetitions, handgrip ≥ 2 kg, back-scratch ≥ 2 cm, and sit-and-reach ≥ 2 cm [4]. High functional response was defined as improvement in at least 50% of available domains. Normality was assessed using the Shapiro-Wilk test. Responder rates were described with 95% confidence intervals, and exploratory comparisons between high responders and other participants used Welch t-tests or Mann-Whitney U tests according to distributional assumptions.

Results: 42/95 participants (44.2%) were classified as high functional responders. The mean Functional Responder Score was $43.3 \pm 32.2\%$. The highest responder rate was observed for 30STS repetitions (63.3%, 95% confidence interval 49.3 to 75.3), whereas the lowest responder rate was observed for Handgrip best (24.2%, 95% confidence interval 16.7 to 33.7). Exploratory predictor analyses did not identify a definitive independent baseline profile of high response; the strongest preliminary association was observed for Baseline 6MWT distance (m) ($p < 0.001$, Rank-biserial $r = -0.44$).

Conclusions: Precision high-intensity interval training produced heterogeneous but clinically interpretable functional responder patterns in fibromyalgia. A domain-based responder profile may complement conventional mean-change analyses and help identify patients who

benefit most from individualized exercise prescription. These findings are exploratory and require confirmation in larger, pre-specified responder analyses.

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Award: Yes as Young Researcher (under 35 years)

Abstract 56

FIBROGENHIIT PROJECT: DO PERCEIVED CLINICAL IMPROVEMENTS REFLECT OBJECTIVE FUNCTIONAL GAINS IN FIBROMYALGIA?

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Background: In fibromyalgia, patient-reported clinical improvement is central to evaluating treatment response, but it is unclear whether perceived improvement reflects objective functional gains after precision exercise.

Objective: To determine whether changes in Fibromyalgia Impact Questionnaire-Revised (FIQR) scores are associated with objective functional adaptations after the FIBROGENHIIT precision HIIT intervention [1-4].

Methods: This secondary exploratory analysis used the FIBROGENHIIT dataset and included participants allocated to the HIIT intervention arms with valid baseline and post-intervention FIQR data (n=63; age 52.0 ± 10.5 years; women 98.4%). Perceived clinical improvement was defined as the inverse of Δ FIQR, so that higher values indicated greater improvement. Objective functional outcomes included changes in 6-minute walk distance, 30-s sit-to-stand, handgrip strength, sit-and-reach, back-scratch, and, in the CPET subcohort, VO₂peak and Wattmax. Normality was assessed using Shapiro-Wilk tests. Correlations were tested using Pearson or Spearman coefficients according to distributional assumptions. LASSO regression was used to test whether objective functional gains independently explained FIQR improvement; because LASSO did not retain robust predictors, a sensitivity model using the two strongest candidate motor outcomes was reported with HC3 robust standard errors [5].

Results: FIQR improved significantly from baseline to post-intervention (mean Δ =-8.59 ± 14.93, p=4.37e-05). The strongest association between FIQR improvement and objective functional change was observed for Δ 6MWT m (r=0.27, 95% CI -0.09 to 0.56, p=0.139). Overall, correlations between perceived improvement and objective functional gains were modest and heterogeneous. Because LASSO did not retain objective functional predictors, the candidate sensitivity model including Δ 6MWT and Δ 30STS explained R²=0.130 of FIQR improvement variance (n=32), indicating limited concordance between subjective and objective adaptations.

Conclusions: In the FIBROGENHIIT precision HIIT intervention, perceived clinical improvement did not uniformly mirror objective functional gains. These findings support the combined use of patient-reported outcomes and objective functional testing to evaluate personalized exercise response in fibromyalgia.

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Award: Yes as Young Researcher (under 35 years)

Abstract 57

THE FORCE-VELOCITY PROFILE IN THE KETTLEBELL SWING FOR TESTING POWER PERFORMANCE

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This study analyzed the evolution of force, velocity, and mean power during the Kettlebell Swing under incremental loading to identify the optimal load for peak power output. The primary objective was to investigate the correlation between this optimal load and the subjects' percentage of body mass (BM). Establishing such a trend provides strength and conditioning professionals with a rapid, reliable assessment method to optimize explosive strength training while reducing testing time. Additionally, the research examined the correlation between maximal performance in the standing long jump (SLJ) and the Kettlebell Swing at optimal load. Since both movements share a horizontal pivot-throw biomechanical pattern, these exercises were analyzed to evaluate training transfer based on the principle of dynamic correspondence (1). Finally, the study aimed to identify an optimal movement velocity range within the load-velocity profile as a practical parameter for training prescription.

Twenty physically active men (age 26.2 ± 2.3 years; body mass 78.0 ± 8.1 kg) with previous strength training experience participated in this single-session study. Testing was conducted while controlling for circadian rhythms and standardizing preparatory conditions (abstention from exercise, caffeine, and alcohol). Following anthropometric measurements and a standardized warm-up, subjects performed two functional assessments: a Standing Long Jump (SLJ) Test and an incremental Kettlebell Swing Test.

The Kettlebell Swing Test (performed according to RKC Hardstyle standards) utilized an adjustable kettlebell with load increments of 5–10 kg until technical failure. To standardize the movement and prevent mean power limitations, an acromion-height marker was used (2). Kinematics and kinetics (force, velocity, mean and peak power) were recorded at 80 Hz using an accelerometer (Enode Pro) (3) attached to the implement, synchronized with 4K, 60 fps video recordings. To normalize and analyze the biomechanical data, the concentric phase of the three valid middle repetitions from each set was segmented into 5 key points, resulting in 4 phases and 12 overall subphases. The SLJ Test consisted of 3 maximal countermovement attempts at a self-selected depth. Subjects were provided with an external attentional cue to maximize horizontal distance (4), and the best distance from the take-off line to the rearmost heel was recorded.

All 20 subjects completed the study. Friedman tests revealed highly significant differences ($p < 0.001$) in mean power (P_{mean}), mean force (F_{mean}), and mean velocity (V_{mean}) across loading conditions. Load-power and load-force profiles showed a linear relationship as load increased, demonstrating a strong positive correlation ($\rho = 1.00$; $p < 0.001$). Conversely, the load-velocity profile showed a very weak, non-significant correlation ($\rho = 0.045$; $p = 0.903$). Regarding P_{peak} at O_{load} , subjects were categorized into seven subgroups based on their

specific optimal load: 42 kg (n=2), 47 kg (n=2), 52 kg (n=7), 57 kg (n=2), 62 kg (n=2), 67 kg (n=3), and 77 kg (n=2). The Kruskal-Wallis test showed significant differences in power output between these groups ($p=0.045$). Furthermore, comparing the optimal load with the preceding condition (P_{pre}) confirmed significantly different peak power outputs ($p<0.001$). P_{peak} was identified at an average load of 57 ± 10 kg, corresponding to $73 \pm 11\%$ of the subjects' BM. Correlation analysis between P_{peak} and SLJ performance revealed a very weak, non-significant negative correlation ($\rho=-0.08$; $p=0.738$).

The Kettlebell Swing proved to be a biomechanically accessible and effective alternative to Olympic weightlifting for developing maximal power. Since P_{peak} consistently occurred at approximately 73% of BM, strength and conditioning coaches can effectively profile athletes by testing loads at 60%, 70%, and 80% of BM. This approach allows for the identification of the optimal load for power production without the need for time-consuming incremental protocols. No P_{peak} -SLJ correlation was found, likely due to low task familiarity; therefore, the expected dynamic correspondence (1) was not observed, requiring further transfer-of-training studies.

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Award: Yes as Young Researcher (under 35 years)

Abstract 58

CORRELATION BETWEEN SESSION-RPE AND HEART RATE-BASED TRAINING LOAD (EDWARDS TRIMP) IN AMATEUR SOCCER PLAYERS DURING A COMPETITIVE MESOCYCLE

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Background: Monitoring internal load in team sports is a common practice in the training process. Among the most used methods are session Rating of Perceived Exertion (sRPE) and heart rate-based measures. Although these methods have been shown to be strongly related in the literature [1,2,3], their relationship in real competitive settings, especially in amateur soccer, is still not fully explored.

Objective: To analyze the relationship between sRPE and internal load calculated using the Edwards method during a competitive mesocycle in amateur soccer players.

Methods: Twenty-three soccer players were monitored during a competitive mesocycle including training sessions and matches. Internal load was measured using sRPE (CR-10 scale × session duration), collected about 30 minutes after exercise, and using the Edwards method (Edwards TRIMP), calculated based on time spent in different heart rate zones weighted by specific coefficients. Heart rate data were collected using a Polar H10 chest strap and recorded with Polar Team software. The relationship between the two methods was analyzed using Pearson's correlation coefficient.

Results: A very strong positive correlation was found between session-RPE and heart rate-based internal load (Edwards TRIMP), with a Pearson correlation coefficient of $r = 0.966$ ($p < 0.001$).

Conclusions: These results show that sRPE is a valid and practical tool for monitoring internal load in soccer, especially at the amateur level, with strong agreement with heart rate-based methods.

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