



PFS
ACADEMY

SCIENCE
IN FOOTBALL
INTERNATIONAL CONFERENCE

4 - 5 MAY 2026
CIDADE DO FUTEBOL

MENSAGEM DO PRESIDENTE

A afirmação da Federação Portuguesa de Futebol como polo dinamizador do saber e da investigação científica aplicados ao desenvolvimento da modalidade tem no PFS Academy - Science in Football um marco de inovação na abordagem de uma área estruturante do projeto que tenho o privilégio de liderar. Para além de uma apaixonante jornada de partilha de conhecimento, sob o tema 'The Team Behind the Team: Science, Training and Performance', estes dois dias de celebração do conhecimento, na Cidade do Futebol, representam uma nova forma de promoção da marca FPF, com a agregação do congresso da FPF Academy ao universo dos eventos do Portugal Football Summit, o grande palco mundial da discussão desta indústria.

Esta abordagem integrada potencia o valor inestimável dos oradores que marcam presença neste PFS Academy - Science in Football e contribui para a consolidação do Portugal Football Summit no panorama internacional, com uma amostra dessa excelência com que nos propomos posicionar a Federação Portuguesa de Futebol na vanguarda do conhecimento desportivo. Este propósito constitui um dos pilares da nossa ação para os próximos 12 anos.

No Plano Estratégico 2024-36 está traçado o caminho para fazer da FPF plataforma de conhecimento e inovação, a base da capacitação de todos os agentes desportivos, referência internacional ao nível do conhecimento e da investigação científica essenciais ao sucesso. Esta nossa aposta no reforço da formação, através da FPF Academy, conduzirá, em breve, à primeira licenciatura em Futebol. O talento que distingue os nossos agentes desportivos exige essa excelência académica que estamos a construir. O desenvolvimento e a resiliência do futebol em todas as vertentes - futsal, futebol de praia, walking football - reclamam este investimento, com importante impacto social na promoção da prática desportiva em todas as etapas da vida.

Mote deste PFS Academy - Science in Football, a multidisciplinaridade que se conjuga no sucesso do desempenho individual e coletivo no futebol faz convergir para a Cidade do Futebol uma amostra brilhante do talento académico que nutre áreas tão aliantes quanto decisivas no futuro da modalidade. Em nome da Federação Portuguesa de Futebol, dou as boas-vindas a todos aqueles que, através da investigação, partilha e discussão, dão corpo a esta jornada que marca uma nova era. Também neste campo podemos afirmar que vai dar Portugal!

D.I.D.I.

PEDRO PROENÇA

PRESIDENTE DA FEDERAÇÃO PORTUGUESA DE FUTEBOL





Entrevista

JOSÉ GOMES MENDES

Diretor Geral da FPF Academy

Qual a expectativa para este encontro entre futebol e ciência promovido pelo Portugal Football Summit Academy?

Gostava de começar por referir que o futebol de hoje é bem diferente do futebol de há duas, três ou mais décadas. Para além do talento natural, e esse emerge sempre da quantidade, releva hoje o talento induzido, que resulta de modelos de formação que integram metodologias de aprendizagem e desenvolvimento com a ciência, aplicada na perspetiva do sucesso desportivo.

Essa é uma das razões pelas quais Portugal, apesar da sua demografia desfavorável, se tem afirmado como uma nação de futebol, capaz de se bater com qualquer país e qualquer seleção, independentemente da respetiva dimensão. Somos um outlier, mas essa condição não é um resultado do acaso.

Nós incorporamos o conhecimento e, como tal, valorizamos a sua produção, partilha e disseminação. É por isso que a FPF Academy organiza esta importante conferência científica, no âmbito da Portugal Football Summit, para a qual as expectativas são muito elevadas.

Estou certo de que a participação, que ultrapassa as duas centenas de inscritos, bem como os resultados e as oportunidades de networking corresponderão às expectativas e contribuirão para a afirmação de Portugal e da nossa Federação como uma nação líder no progresso internacional do futebol.

O que levou à escolha do tema deste congresso: as equipas por detrás das equipas?

A metamorfose ocorrida no futebol nos últimos anos reclama uma maior aproximação entre quem estuda o jogo e quem o executa. O jogador e o treinador continuam a deter a primazia, mas por detrás da equipa que entra em campo existe uma equipa, tantas vezes invisível, que junta os ingredientes necessários para a procura do sucesso.

É para dar visibilidade a essa equipa de retaguarda, que produz a informação necessária para a decisão do treinador, e para apresentar e debater os seus fundamentos científicos e as suas ferramentas operacionais, que a equipa científica da FPF Academy, coordenada pelo professor André Seabra, desenhou um programa imperdível.

Assim, juntamos especialistas em áreas tão críticas como gestão de carga, análise de jogo, scouting, nutrição, psicologia e reabilitação baseada em evidência. Mas mais do que os temas, relevo a qualidade dos palestrantes, oriundos de prestigiadas organizações e clubes como a FIFA, a UEFA, universidades de referência e clubes de topo de vários campeonatos, incluindo o inglês e o português.

Ao nível da formação, a FPF Academy é também a equipa na base da capacitação de todos os agentes desportivos?

Neste último ano, a FPF Academy estruturou o seu

projeto educativo e científico alinhando pelos mais elevados padrões internacionais. As pirâmides formativas estão definidas e caracterizadas para os diferentes pilares da sua oferta, cobrindo de forma abrangente o ecossistema do futebol, na sua diversidade de agentes desportivos.

Assim, estão definidos pirâmides e perfis de oferta para a formação não conferente de grau, para os cursos UEFA de treinador e para a formação conferente de grau académico, que está em fase de desenvolvimento e acreditação.

O cluster de conhecimento centrado na FPF Academy, quer através dos seus profissionais altamente qualificados, quer através dos especialistas de dimensão científica e prática que conosco colaboram, não tem par em Portugal e é a garantia de que os profissionais do futebol, mas também os amadores e os aspirantes, têm aqui um espaço de formação e aprendizagem que responde às suas necessidades.

Como situa a FPF Academy no contexto da ciência e da formação no futebol em Portugal?

Em Portugal existem algumas iniciativas de formação na área do futebol, que se limitam a oferecer cursos sem dispor de recursos científico-pedagógicos internos, quando muito protocolando com universidades ou escolas externas.

Esse não é o caso da FPF Academy, que dispõe hoje de cultura, meios e curriculum significativos no domínio da atividade científica e da formação, que estão devidamente quantificados.

Para se ter uma ideia, trabalham hoje na FPF 13 colaboradores doutorados, com formação na área científica das ciências do desporto, e expertise em disciplinas como saúde, educação, análise de desempenho, ciência de dados e direito do desporto. A estes acrescem profissionais altamente competentes, em diferentes perfis, incluindo na gestão, nas infraestruturas, nos eventos e na governação internacional. Estão em curso 23 teses de doutoramento – que

somam às 7 já concluídas – cuja investigação decorre na FPF com supervisão de colaboradores doutorados da FPF e com bolsas da FCT, sendo o grau conferido por universidades nacionais, no quadro de centros de investigação acreditados.

A relação entre conhecimento e formação é central na FPF Academy, pelo que os nossos programas de formação refletem o estado da arte do conhecimento e proporcionam o acesso a profissionais de topo, como é o caso dos que acompanham as quase 30 seleções nacionais de futebol, futsal, futebol de praia, masculino e feminino.

Quais são os desafios no futuro próximo para a FPF Academy?

O nosso plano estratégico é muito claro e integra-se no Plano Estratégico da Federação Portuguesa de Futebol para o período 2024-2036, recentemente aprovado. Neste contexto, e sem procurar ser exaustivo, gostaria de referir três desafios emblemáticos. O primeiro, de curto prazo, é a descentralização da oferta formativa, tirando partido na recente inauguração do novo polo da FPF na cidade do Porto. Iniciámos já um plano de oferta para esta geografia, que certamente satisfará os anseios de muitos dos que nos procuram com o objetivo de se qualificarem. O segundo desafio é o novo edifício da FPF Academy na Cidade do Futebol, em Oeiras, cujo projeto está já em marcha e que permitirá escalar a nossa operação e assim impactar de forma mais intensa o ecossistema do futebol.

Na sequência do anterior, a nova casa será a base do futuro Instituto Universitário do Futebol, um projeto muito ambicioso, pioneiro no mundo, que permitirá aos jovens portugueses obter os seus graus académicos de licenciatura, mestrado e doutoramento nas temáticas do futebol, da ciência do desporto à gestão e à governação. Iniciámos já o processo de acreditação institucional e dos ciclos de estudos, que, como se sabe, é extremamente exigente.



Entrevista

JOÃO MEDEIROS CARDOSO

Chief Marketing & Commercial Officer
Federação Portuguesa de Futebol

O Portugal Football Summit ganhou, em pouco tempo, identidade própria e reconhecimento internacional. O que representa para a marca receber, este ano, a integração do congresso científico da FPF Academy?

A integração do PFS Academy – Science in Football no ecossistema do Portugal Football Summit é um passo natural e profundamente estratégico. A marca PFS nasceu para ser uma plataforma internacional de conhecimento, diálogo e inovação na indústria do desporto. Ao associarmos ao Portugal Football Summit um congresso científico de elevada credibilidade, enriquecemos a marca com uma dimensão que sempre esteve no seu ADN: a ligação entre o jogo e o conhecimento.

O que acontece nestes dois dias, na Cidade do Futebol, reforça precisamente essa ambição. Trazemos para o universo do PFS especialistas de referência mundial como representantes da FIFA, Liverpool FC, Tottenham, SL Benfica ou investigadores das

principais universidades internacionais. Este nível de excelência acrescenta profundidade à marca e posiciona Portugal como um país que não segue, mas lidera a evolução do futebol no plano científico.

Que impacto concreto tem esta parceria na afirmação internacional do Portugal Football Summit?

O Portugal Football Summit começou como uma visão: criar, a partir de Portugal, uma marca global capaz de gerar conversas que impactem a indústria. O primeiro grande evento internacional, realizado no ano passado, confirmou que existe espaço e procura por uma abordagem portuguesa, moderna, aberta ao mundo e sustentada em conhecimento.

A integração do Congresso Internacional Science in Football no universo do Portugal Football Summit reforça esta trajetória. Não se trata da entrada da FPF Academy na marca, mas de trazer para o PFS um dos seus grandes temas estruturantes,

o conhecimento científico aplicado ao jogo, e aprofundá-lo num momento dedicado. Esta abordagem faz parte da nossa estratégia: criar espaços específicos para explorar, em detalhe, tópicos que depois convergem no evento principal de setembro. Ao fazê-lo, mostramos que Portugal não se limita a organizar eventos; produz conhecimento, atrai especialistas, promove debate qualificado e constrói pontes entre ciência, formação e prática. Isso dá ao PFS uma credibilidade e uma densidade que fortalecem ainda mais a sua afirmação internacional.

Pode explicar de que forma o reforço da componente científica beneficia também a marca da Federação Portuguesa de Futebol?

A FPF vive um momento decisivo no seu caminho de afirmação como instituição de conhecimento. A aposta estruturada na FPF Academy, o investimento contínuo em investigação, as dezenas de teses de doutoramento em desenvolvimento e, sobretudo, o projeto da primeira universidade do futebol, demonstram de forma inequívoca a ambição que estamos a concretizar. É um passo histórico para Portugal e um sinal claro de como queremos liderar o futuro do futebol através da ciência, da formação e da inovação.

O Portugal Football Summit potencia esta estratégia, funcionando como uma montra internacional do que Portugal faz de melhor: transformar conhecimento em evolução competitiva. Quando associamos a marca FPF a um ambiente onde se discutem temas como análise de jogo, gestão de carga, scouting moderno, nutrição, psicologia ou reabilitação baseada em evidência, estamos a reforçar a nossa credibilidade junto do ecossistema global do futebol. E isso projeta o país e a Federação numa direção muito ambiciosa e muito clara: a liderança.

Com o lançamento de novos projetos, um podcast e uma newsletter, podemos dizer que PFS já não é apenas um evento?

São peças fundamentais. O Portugal Football Summit Podcast, com entrevistas profundas a líderes do

desporto, e a PFS Newsletter, que queremos que se afirme como um conteúdo de referência na indústria, cumprem um objetivo central: manter viva a marca ao longo do ano e reforçar a sua autoridade no debate internacional.

O sucesso da marca depende precisamente desta continuidade. Não basta realizar um grande evento anual. É preciso alimentar a comunidade, criar conhecimento útil, gerar conversas relevantes e mostrar que Portugal tem voz própria neste setor. Estes projetos já demonstram que o PFS é mais do que um Summit: é uma plataforma de influência.

Como olha para o futuro da marca Portugal Football Summit?

O futuro do Portugal Football Summit é de crescimento sustentado e ambição internacional. A marca já não é apenas um conjunto de iniciativas, é um ecossistema que está a ganhar escala, profundidade e reconhecimento lá fora. O seu evento central, que regressa em setembro, está rapidamente a tornar-se uma referência no calendário desportivo internacional, reunindo líderes, decisores e especialistas de várias áreas da indústria.

O PFS Academy – Science in Football é uma peça importante neste percurso, porque acrescenta densidade científica e reforça o posicionamento do PFS como plataforma de conhecimento. Mas a marca vai mais além. A consistência dos conteúdos, a expansão da comunidade, o Podcast e a Newsletter, e a capacidade de ligar Portugal às principais conversas globais fazem do Summit um projeto com enorme margem de evolução.

Vejo o PFS a afirmar-se como uma marca global, capaz de influenciar tendências, aproximar diferentes setores do desporto e reforçar o papel de Portugal na vanguarda da inovação e do pensamento estratégico nesta indústria.

SCHEDULE

PROGRAM • MAY 4TH

09H00 FREE COMMUNICATIONS

10H45 OPENING CEREMONY



PEDRO PROENÇA
PRESIDENT • FPF



JOSÉ GOMES MENDES
GENERAL MANAGER • FPF ACADEMY

11H00 The Team Behind the Team



PEDRO MIL-HOMENS
TECHNICAL LEAD • FIFA ACADEMY
SYSTEMS PROJECT

11H30 COFFEE BREAK

11H45 CONFERENCE 1 | The Assistant Coach role: A reflection on differences and similarities between National Team and Club Football.



HUGO PEREIRA
HIGH PERFORMANCE SPECIALIST • FIFA

12H15 CONFERENCE 2 | Optimizing Player Pathways: Scientific Principles and Practical Approaches in Coach Support



RICARDO DUARTE
FPF

12H45 LUNCH BREAK

14H00 CONFERENCE 3 | Neuromuscular demands of football: Physiological impact, response and adaptation – the interplay between gym – and pitch-based stimuli. A delicate balance or an assumed risk zone?



ANTÓNIO ASCENSÃO
UNIVERSITY OF PORTO

14H30 CONFERENCE 4 | Enhancing the training process: determining the individual and team physical profile through the evaluation of on-field protocols



EDUARDO OLIVEIRA
FPF

15H00 BREAK

15H15 CONFERENCE 5 | How does science guide us in training our goalkeepers?



MARKEL PEREZ-ARRONIZ
UNIVERSITY OF THE BASQUE COUNTRY

15H45 CONFERENCE 6 | Modern Scouting in Elite Football Environments



JOÃO FERREIRA
TOTTENHAM HOTSPUR FC

16H15 COFFEE BREAK

16H30 CONFERENCE 7 | Training load management from research to practise



TORSTEIN DALEN-LORENTSEN
SINTEF

17H00 CONFERENCE 8 | Training and match load analysis: from data to informed decision-making



CATARINA BAJANCA
SL BENFICA

PROGRAM • MAY 5TH

09H00 FREE COMMUNICATIONS

10H30 CONFERENCE 9 | Managing Multidisciplinary Teams in Elite Football



PEDRO MARQUES
LIVERPOOL FC

11H00 CONFERENCE 10 | Set Pieces in International Football: A Conceptual Approach



ANDRÉ REIS
FPF

11H30 COFFEE BREAK

11H45 CONFERENCE 11 | Food and Nutrition Around Exercise: What to eat before, during and after training and competition



MÓNICA SOUSA
HEAD OF NUTRITION DEPARTMENT OF
COD • SPORTING CLUBE DE PORTUGAL

12H15 CONFERENCE 12 | Sport Psychology: a journey from health to performance



NÁDIA TAVARES
FPF

12H45 LUNCH BREAK

14H00 CONFERENCE 13 | Science: friend or foe of the Team Doctor?



RITA TOMÁS
FPF

14H30 CONFERENCE 14 | Rehab by the Evidence: A Multidisciplinary Approach in Elite Football



NUNO TIAGO
FPF

15H00 BREAK

15H15 CONFERENCE 15 | Football Analytics with Generative AI: From Tracking Data to Meaningful Variables



DANIEL CARRILHO
UNIVERSITY OF LISBON

15H45 CONFERENCE 16 | Decoding Playing Styles in Elite Football: Practical Insights for Coaches



JAVIER FERNÁNDEZ NAVARRO
MANCHESTER METROPOLITAN
UNIVERSITY

16H15 COFFEE BREAK

16H30 CONFERENCE 17 | The pitch is our lab: supporting decisions with science, knowledge and practice



ANDRÉ SEABRA
FPF



JOÃO BRITO
FPF



ÓSCAR TOJO
FPF

17H00 CLOSING CEREMONY



HELENA PIRES
CEO • FPF

INVESTIGAÇÃO E TRANSFERÊNCIA DE CONHECIMENTO



23

**PROJETOS DE DOUTORAMENTO
COM BOLSAS FCT
(+9 VS. 2024/2025)**



**PROPOSTA DE
NOVAS LINHAS
DE INVESTIGAÇÃO**

**PORTUGAL
FOOTBALL
REFEREEING
RESEARCH HUB**

**DESENVOLVIMENTO
E INOVAÇÃO NO
FUTSAL E FUTEBOL
DE PRAIA**



PROJECTOS

FIFA



**world
anti-doping
agency**



fct Fundação
para a Ciência
e a Tecnologia



PUBLICAÇÕES

+250

**ARTIGOS
CIENTÍFICOS**

14

LIVROS



**ORGANIZAÇÃO DA CONFERÊNCIA
CIENTÍFICA INTERNACIONAL**

ANO	NOME DO EVENTO	PARTICIPANTES	PAÍSES
2018	Football is Medicine	105	-
2019	Football Refereeing	232	-
2020	Nutrition and Football	153	-
2022	Ciência e Futebol	224	-
2023	Desporto para Crianças e Jovens	230	-
2024	Applied Science in Football	250	18
2025	Scientific Insights in Football Training	250	36

LISTA DE PROJETOS

SUPER QUINAS IN PRESCHOOL

Estudante: Maurício Fernandes

Instituição: Universidade Lusófona

Equipa de Orientação: Inês Aleixo; Júlio Costa; André Seabra

MOTOR COMPETENCE AND MENTAL HEALTH IN CHILDREN

Estudante: Francisco Ferreira

Instituição: Universidade da Maia

Equipa de Orientação: Gustavo Silva; Júlio Costa; André Seabra

SHINE - SUPER QUINAS IMPACT EVALUATION

Estudante: João Gonçalves

Instituição: Universidade do Minho

Equipa de Orientação: Rute Santos; Paulo Mourão; André Seabra

FAIR GAME

Estudante: Cristiana Santos

Instituição: Universidade da Beira Interior

Equipa de Orientação: Bruno Travassos; Katrine Kryger; João Brito

COGNITIVE SKILLS IN EXPERT FUTSAL COACHING

Estudante: Bruno Fernandes

Instituição: Universidade do Minho

Equipa de Orientação: José Keating; Bruno Travassos; Manuel Rodrigues

ACL INJURY REDUCTION

Estudante: Maria Santos

Instituição: Universidade de Lisboa

Equipa de Orientação: António Veloso; João Brito

CREATIVITY ENVIRONMENTS IN FEMALE YOUTH FOOTBALL

Estudante: André Marinho

Instituição: UTAD

Equipa de Orientação: Sara Santos; Bruno Gonçalves; André Seabra

KICK4CR

Estudante: Patrícia Grave

Instituição: Universidade do Minho

Equipa de Orientação: Rute Santos; Catarina Tomás; André Seabra

VISUAL ATTENTION IN FEMALE FOOTBALL

Estudante: Diana Oliveira

Instituição: Universidade de Coimbra

Equipa de Orientação: Miguel Castelo-Branco; Duarte Araújo; Bruno Travassos

COOLING THE GAME

Estudante: Francisco Diogo
Instituição: Universidade de Lisboa
Equipa de Orientação: Joana Reis; João Brito

WALKING FOOTBALL FOR ACTIVE AGEING

Estudante: Francisco Santos
Instituição: Universidade Coimbra
Equipa de Orientação: Élvio Gouveia; Hugo Sarmento; André Seabra

WEMOTIONAI

Estudante: Rute Carvalho
Instituição: UTAD
Equipa de Orientação: Bruno Travassos; Jaime Sampaio; Júlio Costa

FIELD PROTOCOL FOR ACL RISK

Estudante: Sandra Salvador
Instituição: Universidade de Lisboa
Equipa de Orientação: Sílvia Cabral; António Veloso; João Brito

ACL INJURIES IN ELITE FEMALE PLAYERS

Estudante: Sara Oliveira
Instituição: Universidade de Lisboa
Equipa de Orientação: António Veloso; João Brito

AI IN FOOTBALL ANALYSIS

Estudante: Sofia Ferreira
Instituição: Universidade de Lisboa
Equipa de Orientação: Duarte Araújo; João Brito

ELASTIC BAND TRAINING

Estudante: Henrique Sousa
Instituição: Universidade da Maia
Equipa de Orientação: Rui Marcelino; João Brito

MOST INTENSE PERIODS OF ACTIVITY

Estudante: Farzad Yousefian
Instituição: Universidade Beira Interior
Equipa de Orientação: Bruno Travassos; João Brito

DASHBOARD FOR WOMEN'S FOOTBALL

Estudante: Rafael Lopes
Instituição: Universidade Beira Interior
Equipa de Orientação: Bruno Travassos; João Brito

SLEEP OF FOOTBALL ATHLETES

Estudante: Lúcio Cunha
Instituição: Universidade da Maia
Equipa de Orientação: Pedro Figueiredo; João Brito

FOOD ORDER & METABOLIC MARKERS

Estudante: Rita Giro
Instituição: Universidade do Porto
Equipa de Orientação: Vitor Hugo Teixeira; Nuno Borges; João Brito

BEAT THE HEAT

Estudante: Catarina Oliveira
Instituição: Universidade Nova de Lisboa
Equipa de Orientação: Mónica Sousa; Hélder Dores; João Brito

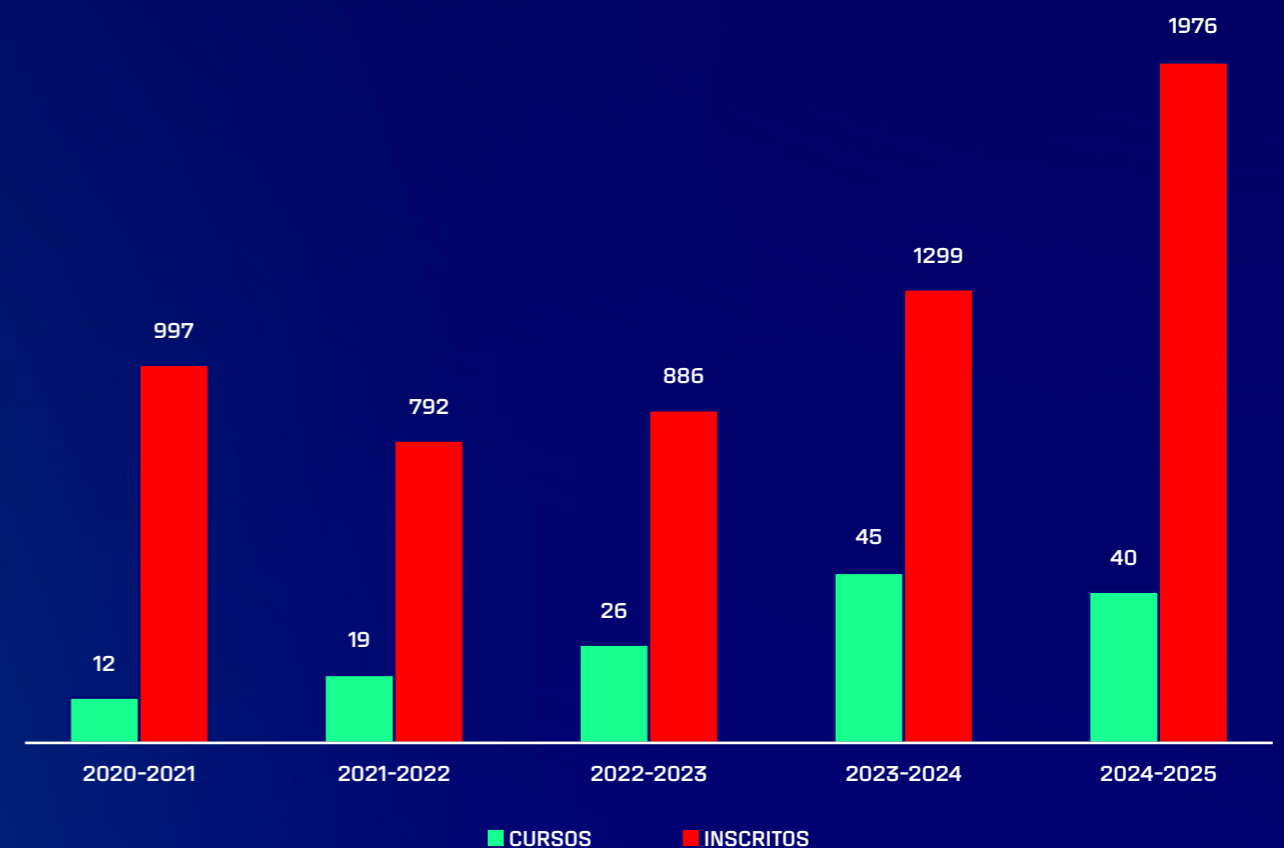
SLEEP & FATIGUE IN YOUTH PLAYERS

Estudante: João Barreira
Instituição: Universidade da Maia
Equipa de Orientação: Pedro Figueiredo; João Brito

MACHINE LEARNING FOR INJURY PREVENTION

Estudante: Alberto Cortez
Instituição: Universidade de Évora
Equipa de Orientação: Bruno Gonçalves; João Brito

Nº DE INSCRITOS NOS CURSOS DA FPF ACADEMY EVOLUÇÃO ÚLTIMAS 5 ÉPOCAS



ABSTRACTS • MAY 4TH

AUDITORIUM	ROOM 1	ROOM 2
<p>09H00 Match Phase Influences the Locomotor Composition of Peak Kinematic Demands in Elite Male Football</p> <p>FARZAD YOUSEFIAN</p>	<p>09H00 Comparison of Weeks with Three Versus Four Training Sessions Using Training_Match Ratios in Elite Female Portuguese Soccer Players</p> <p>RAFAEL OLIVEIRA</p>	<p>09H00 Performance Metrics and Player Progression in Soccer - A Retrospective Observational Analysis</p> <p>LILIAN DUFOSSÉ</p>
<p>09H15 An Exploratory Analysis of Contextual Factors in Most Intense Periods in Elite Football</p> <p>SOFIA FERREIRA</p>	<p>09H15 Where Should He Stand Inverse Modeling of Player Positioning in Soccer</p> <p>OMAR REFAAT</p>	<p>09H15 Analysis of the Offensive Process of Successful Teams in the 2022 FIFA World Cup</p> <p>ANDRÉ BARRETO</p>
<p>09H30 Machine Learning-Based Characterization of Shot Opportunities in the Most Demanding Passages in Elite Soccer</p> <p>ALBERTO CORTEZ</p>	<p>09H30 Reversing the Game - Invertible Pitch Control for Tactical Inference and Design</p> <p>ZEYAD ABDELFAHATTAH</p>	<p>09H30 The impact of playing three matches a week in hot environments on performance for different positions</p> <p>MIKINOBU YASUMATSU</p>
<p>09H45 Analysis of attacking performance data in the English Premier League</p> <p>ISLAM MAHMOUD</p>	<p>09H45 From Spatiotemporal Data to Decision-Making - Applied Pitch Control Frameworks in Elite Football</p> <p>JOSÉ SILVA</p>	<p>09H45 External Load Quantification of Professional Women Soccer Players</p> <p>RENATO FERNANDES</p>
	<p>10H00 Unfolding Collective Behaviour Patterns in Elite Football Through Multiple Factor Analysis and Hierarchical Clustering on Principal Components A Mixed-Data Framework for Performance Analysis</p> <p>LUÍS CALDEIRA</p>	<p>10H00 Workload Distribution Across Matches and Compensatory Sessions According to Starting Status in Highly Trained Youth Soccer Players</p> <p>GONÇALO REIS</p>
	<p>10H15 Analysis of Tactical and Network Variability in Team Behaviour through Mathematical Models and Social Network Analysis A Case Study of Portugal U-17 at the 2025 World Cup</p> <p>JOSÉ GAMA</p>	<p>10H15 Does External Load Influence Sleep Metrics in Football Players</p> <p>LÚCIO CUNHA</p>

ROOM 4	ROOM 5
<p>09H00 Changes in Hip Adductor Strength and Associations with Internal Load in Under-19 Female Futsal Athletes During Competitive Tournament Conditions</p> <p>KONSTANTINOS SPYROU</p>	<p>09H15 Influence of playing experience on behavioural responses of under-14 football players during small-sided games</p> <p>RODRIGO SILVA</p>
<p>09H30 Position-Specific External Load Benchmarks in Elite International Beach Soccer - Per-Minute GPS-Derived Match Demands</p> <p>RUI MARCELINO</p>	<p>09H30 Behavioural adaptations across the competitive season in under-14 football players during small-sided games</p> <p>PAULO PEREIRA</p>
<p>09H45 Impact of MD+2 Training on Internal and External Load in MD-4 - Differences Between Starters and Non-Starters in Elite Youth Football</p> <p>HUGO FERREIRA</p>	<p>09H45 Cognitive Functioning and Sports Performance in Young Footballers - Exploring Potential Influences</p> <p>GONÇALO SANTOS</p>
	<p>10H00 Impact of the introduction of VAR on the satisfaction, performance and retention of football referees in Portugal</p> <p>EDUARDO FERREIRA</p>
	<p>10H15 Neurocognitive analysis and inter-rater reliability of a systematic video analysis of ACL injuries in elite men's football</p> <p>MARIA CASTELA</p>
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<p>13H45 Walking Football in active ageing - football background, interruption, and re-entry into sport participation in a competitive national tournament context</p> <p>MARCO GONÇALVES</p>	<p>13H45 Task-specific external load quantification in a female soccer goalkeeper - a novel performance-based approach</p> <p>PABLO LÓPEZ-SIERRA</p>



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ABSTRACTS • MAY 5TH

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CHANGES IN HIP ADDUCTOR STRENGTH AND ASSOCIATIONS WITH INTERNAL LOAD IN UNDER-19 FEMALE FUTSAL ATHLETES DURING COMPETITIVE TOURNAMENT CONDITIONS

Konstantinos Spyrou^{1,2*}, Lucio Marcial Granea¹, Pedro E. Alcaraz^{1,2}, Maziar J. Hamad^{1,2}

*Corresponding author:
Konstantinos Spyrou
+34 666959502
kspyrou@ucam.edu

This study aimed to evaluate changes in hip-adductor isometric strength pre- and post-matches during an official tournament, and quantify the association between strength and internal load. Nine female futsal players (age: 16.9 ± 0.9 ; weight: 58.2 ± 6.8 ; height: 1.68 ± 0.05 meters; lower limb length: 0.84 ± 0.04) participated. A fixed dynamometer (VALD ForceFrame) was used to measure adductor strength in supine position, before and after each of the three matches. A statistically significant effect of time*game on relative torque was found ($F(2, 37.98) = 4.3980$, $p = 0.019$, $\eta^2 = 0.19$). Specifically, players' strength decreased significantly post-match 3 compared to pre-match 3 ($p = 0.029$; ES (95%CI): 1.07 (0.00 – 2.14), and post-match 1 ($p = 0.007$; ES (95%CI): 1.55 (0.44 – 2.65)). No further statistically significant differences among pre and/or post-matches were found ($p = 0.076$ – 1.000). Then, the percent-change was significantly different between match 1 and match 3 ($p = 0.009$; ES (95%CI): 1.65 (0.67 – 2.63)). There was a statistically significant association between percentage change and RPE ($p = 0.0149$; $r = -0.47$, $R^2 = 0.22$). However, non-significant associations were found between sRPE ($p = 0.0587$; $r = -0.38$, $R^2 = 0.14$) and playing time ($p = 0.27$; $r = -0.22$, $R^2 = 0.05$). The predicted effect (?) was -0.25, -1.72, -0.04 per minute, RPE, and sRPE a.u., respectively. In conclusion, continuous official futsal games may produce decrements in hip-adductor strength and internal load (RPE) was negatively associated with hip-adductor strength, specifically, each 1-unit increase in RPE predicted a 1.7% in decrease in hip-adductor strength.

Keywords: five-a-side football, team sports, performance, fatigue

Conflicts of interest: No conflicts of interest declared by the authors.

INTRA- AND INTER-RATER RELIABILITY OF A SYSTEMATIC VIDEO ANALYSIS OF ACL INJURIES IN ELITE MEN'S FOOTBALL

Sara Oliveira^{1,2*}, Maria M. Castela^{1,2}, António P. Veloso¹, João Brito^{1,2}

*Corresponding author:
Sara Oliveira
+351 968914795
sara.ffoliveira22@gmail.com

Introduction: Video analysis is a crucial tool for understanding anterior cruciate ligament (ACL) injury mechanisms in football. However, before clinical application, the reliability of observational measurement instruments must be established.

Objective: This study aimed to evaluate the intra- and inter-rater reliability of a systematic video analysis checklist designed to assess ACL injuries in elite men's football.

Methodology: Twenty-five injuries were randomly selected out of 122 ACL injuries identified across four seasons in the top six European leagues. Two independent observers used a predefined checklist to evaluate the following variables: weather conditions, injury side and dominance, game play timing, playing phase, field location third and corridor, player situation, player initial contact and location, injury classification, leg loading, feet on the ground, and horizontal and vertical speeds. To assess intra-rater reliability, a repeated assessment was conducted 60 days after. Categorical variables agreements were analysed using Cohen's kappa (κ) coefficient, and quantitative variables using two-way mixed models Intraclass Correlation Coefficients (ICC 3,1) with absolute agreement, following normality and variance homogeneity checks.

Results and Discussion: Intra- and inter-rater reliability were almost perfect (κ /ICC > 0.81) for most variables (injury side, dominant leg, playing phase, field location, player initial contact, injury classification, situational pattern, and game play timing). Substantial agreement was found for biomechanical assessments such as contact body location, leg loading, and feet on the ground. Conversely, visual estimation of approach speed proved problematic, with both horizontal and vertical speeds demonstrating fair to moderate reliability, including negative values for horizontal speed indicating worse-than-chance disagreement.

Conclusion: The systematic video analysis checklist demonstrated high reliability for characterizing the environmental, situational, and mechanical features of ACL injuries in elite male football. Given the lack of reliability in visual speed estimation, future epidemiological research should employ this checklist, integrating objective player tracking data to ensure accurate speed measurements.

Keywords: Reliability, Inter-rater, Intra-rater, Video Analysis, ACL injuries, Elite Football

Conflicts of interest: The authors declare a potential conflict of interest as this research is part of a doctoral program hosted and supported by the FPF Academy, the organizing body of this congress. However, the FPF Academy did not influence the scientific execution or the conclusions of this study.

POSITION-SPECIFIC EXTERNAL LOAD BENCHMARKS IN ELITE INTERNATIONAL BEACH SOCCER: PER-MINUTE GPS-DERIVED MATCH DEMANDS

Rui Marcelino^{1,2,3*}, Júlio A. Costa¹, João Brito^{1,4}

¹FPF Academy, Portuguese Football Federation, Oeiras, Portugal; ²Research Center in Sports Sciences, Health Sciences and Human Development, CIDESD, ELITE Research Community, Maia, Portugal; ³Universidade da Maia, Maia, Portugal; ⁴CIPER, Faculdade de Motricidade Humana, Universidade de Lisboa, Portugal

*Corresponding author:
Rui Marcelino
+351 964627652
rui.marcelino@fpf.pt

Introduction: Beach soccer is characterised by intermittent high-intensity actions performed on sand, combined with unlimited substitutions and three fixed match periods. Despite its growth under FIFA governance, normative performance references derived from elite international competition remain limited, particularly using per-minute normalisation to account for variable effective playing time.

Objectives: To establish position-specific per-minute external load benchmarks in elite male beach soccer players during official international matches.

Methodology: Seventeen Tier 5 male players (28.7 ± 5.6 years) from a top-ranked national team were monitored across 35 official matches (2024–2026 seasons). Players were categorised as goalkeepers (n=4), backs (n=3), wings (n=7), and pivots (n=3). Match activity was recorded using 10-Hz GPS units (Statsport Apex 2.0). Effective playing time was determined via manual substitution tracking, and locomotor metrics were normalised per minute of active participation. Variables included total distance, moderate-speed running (12–16 km·h⁻¹), high-speed running (>16 km·h⁻¹), accelerations/decelerations ≥3 m·s⁻², and peak locomotor values. Effect sizes (Hedges' g) with FDR correction were applied.

Results and Discussion: Outfield players covered between 125–138 m·min⁻¹, with wings presenting the highest relative locomotor output. Moderate-speed running represented 15–17% of total distance (19–21 m·min⁻¹), while high-speed running accounted for 4–7% (6–9 m·min⁻¹). Peak running speeds exceeded 21 km·h⁻¹ in wide and defensive roles. Large effect sizes were observed between positional roles, reflecting distinct tactical demands. Match output remained relatively stable across periods when expressed per minute, supporting the suitability of unlimited substitutions in maintaining intensity. Goalkeepers demonstrated lower locomotor volumes, consistent with role-specific tactical responsibilities.

Conclusions: These findings provide the first elite international per-minute external load benchmarks in beach soccer, offering position-specific normative values derived from official competition. The data support evidence-based conditioning design, contextualised positional profiling, and objective monitoring strategies tailored to the unique demands of sand-based match play.

Keywords: locomotor profiling, relative intensity, positional roles, sand surface, performance monitoring

Conflicts of interest: No conflicts of interest declared by the authors.

PERFORMANCE METRICS AND PLAYER PROGRESSION IN SOCCER: A RETROSPECTIVE OBSERVATIONAL ANALYSIS

Lilian Dufossé^{1*}, Jérémy Coquart¹

¹Univ. Lille, Univ. Artois, Univ. Littoral Côte d'Opale, ULR 7369 - URePSSS - Unité de Recherche Pluridisciplinaire Sport Santé Société, F-59000 Lille, France

*Corresponding author:
Lilian Dufossé
+33 06 88 81 59 54
lilian.dufosse.etu@univ-lille.fr

Introduction: Market value is a common performance proxy in professional soccer, yet the sub-elite sector lacks financial indicators, making it difficult to objectively evaluate player potential. Standardized match sheets offer a rich, underutilized source of objective data to assess sporting levels in this context.

Objectives: This study examines correlations between match sheet variables and player progression to higher divisions to develop a predictive model for sub-elite soccer.

Methodology: A retrospective observational study was conducted using data from 4,246 players across the French National 1, 2, and 3 divisions. A stepwise multiple linear regression analysis was performed on variables including playing time, individual statistics, and team results to build a predictive equation for player's progression.

Results: The final model was highly significant (p<0.001), demonstrating that a specific combination of individual performance metrics, team-level statistics, and player characteristics can effectively predict a player's likelihood of reaching a higher division. Notably, the analysis revealed that certain situational variables and behavioral indicators—including specific disciplinary records linked to player status—play a key role in the predictive outcome.

Discussion/Conclusions: Behavioral variables derived from official match sheets are significant indicators of future player trajectories. This research provides sub-elite clubs with a practical, low-cost tool to support recruitment and development strategies. While the model captures a significant portion of the variance, incorporating technical-tactical or external load data could further enhance prediction accuracy in future studies.

Keywords: soccer, sub-elite, predictive, modeling, identification, progression

Conflicts of interest: No conflicts of interest declared by the authors.

COMPARISON OF WEEKS WITH THREE VERSUS FOUR TRAINING SESSIONS USING TRAINING/MATCH RATIOS IN ELITE FEMALE PORTUGUESE SOCCER PLAYERS

Rafael Oliveira^{1,2,3*}, Renato Fernandes^{1,2}, João Paulo Brito^{1,2,3}, Mário C. Espada^{4,5,6,7,8}, Matilde Nalha¹, Fernando J. Santos^{5,6,9}, Ryland Morgans¹⁰

¹Santarém Polytechnic University, School of Sport, Av. Dr. Mário Soares, 2040-413 Rio Maior, Portugal; ²Life Quality Research Centre (CIEQV), Santarém Polytechnic University, Av. Dr. Mário Soares, 2040-413 Rio Maior, Portugal; ³Research Center in Sport Sciences, Health Sciences and Human Development (CIDESD), Santarém Polytechnic University, Av. Dr. Mário Soares, 2040-413 Rio Maior, Portugal; ⁴Life Quality Research Centre (CIEQV-IP Setúbal), Campus do IPS – Estefanilha, 2910-761 Setúbal, Portugal; ⁵Instituto Politécnico de Setúbal, Escola Superior de Educação, 2914-504 Setúbal, Portugal; ⁶Interdisciplinary Centre for the Study of Human Performance (CIPER), Faculdade de Motricidade Humana, Universidade de Lisboa, 1499-002 Lisbon, Portugal; ⁷SPRINT Sport Physical Activity and Health Research & Innovation Center / Centro de Investigação e Inovação em Desporto Atividade Física e Saúde. 2040-413 Rio Maior, Portugal; ⁸Comprehensive Health Research Centre (CHRC), Universidade de Évora, 7004-516 Évora, Portugal; ⁹Faculdade de Motricidade Humana, Universidade de Lisboa, 1499-002 Lisbon, Portugal; ¹⁰School of Sport and Health Sciences, Cardiff Metropolitan University, Cardiff CF23 6XD, UK

*Corresponding author:
Rafael Oliveira
+351 912664494
rafaeloliveira@esdrm.ipsantarem.pt

Load distribution can be influenced by the number of training sessions during the week. Therefore, this study compared weeks with three versus four training sessions plus a match using training/match ratio (TMr) of different external load metrics. Twenty players participated in the study (age 24.7 ± 2.4 years and body mass index 21.81 ± 3.03 kg/m²). Data collection was made across 2019–20 and 2020–21 seasons. In the first season there were three training sessions (3dW) and a match per week, while in the second season there were four training sessions (4dW) plus a match per week. The following metrics were used for analysis: duration, total distance, high-speed running distance (HSR, >15 km/h), number of accelerations (ACC, >1–2 m·s⁻² [ACC1]; >2–3 m·s⁻² [ACC2]; >3–4 m·s⁻² [ACC3]; >4 m·s⁻² [ACC4]) and decelerations (DEC, <1–2 m·s⁻² [DEC1]; <2–3 m·s⁻² [DEC2]; <3–4 m·s⁻² [DEC3]; <4 m·s⁻² [DEC4]). TMr was calculated by dividing the accumulated load of the week by match data. The results showed that all TMr were meaningfully higher in 4dW than 3dW ($p < 0.001$ for all variables) with the exception of ACC4 ($p = 0.796$) and DEC4 ($p = 0.063$). Still, both ACC4 and DEC4 presented higher values in 4dW than 3dW. Moreover, TMr in 4dW presented an increase from 0.83 to 3.41 more arbitrary units than 3dW. In conclusion, the findings suggest that an additional training session per week increased TMr for several running and accelerometry based metrics without compromising match load. As a practical implication, coaches can use the present findings for a better load adjustment, depending on the number of training sessions available in the week, to stabilize (i.e., make more regular) TMr through the season.

Keywords: acceleration, deceleration, external load, football, high-speed running

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COGNITIVE FUNCTIONING AND SPORTS PERFORMANCE IN YOUNG FOOTBALLERS: EXPLORING POTENTIAL INFLUENCES

Gonçalo Costa Santos^{1*}, Pedro B. Albuquerque²

CIPSI, Escola de Psicologia, Universidade do Minho, Portugal

*Corresponding author:
Gonçalo Costa Santos
+351 933445169
goncalocostasantos@gmail.com

Cognitive functioning has been increasingly recognized as an important component of performance in team sports such as football, where players must rapidly perceive, process, and respond to complex and dynamic game situations. Executive functions, including attention, inhibitory control, processing speed, and working memory, are believed to support decision-making and performance in elite players. However, evidence regarding the relationship between domain-general cognitive abilities and competitive success in youth elite football remains limited.

The present study aimed to explore the relationship between cognitive functioning and sports performance in elite youth football players, while also examining potential developmental differences between two age groups.

Participants were 50 male players from a professional football academy, divided into two age categories (U15 and U17). Cognitive functioning was assessed using an open-source cognitive test battery measuring attentional tracking (Multiple Object Tracking), inhibitory control (Go/No-Go), perceptual processing speed (Enumeration), and visuospatial working memory (Corsi Block Task). Sports performance was quantified using official competition indicators, including match appearances, minutes played, and national team participation. These variables were combined to construct a composite Sports Performance Rating for each participant.

Correlation analyses did not reveal significant relationships between performance in cognitive tasks and sports performance ratings in either age group. However, comparisons between age groups indicated that U17 players demonstrated significantly faster response and execution times in several cognitive tasks compared to U15 players, while maintaining similar levels of accuracy.

These findings suggest that domain-general cognitive abilities may not directly predict competitive success among already elite youth football players. Nevertheless, the observed age-related differences highlight developmental improvements in processing speed and executive functioning during adolescence. Future research should integrate ecologically valid and sport-specific cognitive assessments to better understand the role of cognition in football performance and talent development.

Keywords: Cognition, Cognitive Functioning, Executive Functions, Youth Football, Sport Performance

Conflicts of interest: No conflicts of interest declared by the authors.

ANTHROPOMETRIC AND PHYSICAL CHARACTERISTICS OF PORTUGUESE FEMALE FOOTBALL PLAYERS: A COMPARATIVE ANALYSIS ACROSS AGE GROUPS AND TIER LEVELS

Henrique Sousa^{1,2,3*}, Eduardo Abade^{1,2,4}, Filipe Maia^{1,3,5}, Gonçalo Torres^{1,3}, Júlio A. Costa², Rui Marcelino^{1,2,3}

¹Research Center in Sports Sciences, Health Sciences and Human Development, CIDESD, ELITE Research Community, Maia, Portugal; ²FPF Academy, Portuguese Football Federation, Oeiras, Portugal; ³University of Maia, Maia, Portugal; ⁴Department of Sports Science, Exercise and Health, University of Trás-os-Montes e Alto Douro, UTAD, Vila Real, Portugal; ⁵Polytechnic Institute of Maia Research Center (N2i), Maia, Portugal

*Corresponding author:
Rafael Oliveira
+351 912664494
rafaeloliveira@esdrm.ipsantarem.pt

Introduction: Understanding anthropometric and physical fitness profiles across age groups is essential for optimizing training in female football. Despite growing interest in female football development, limited research has examined how these qualities differ across competitive levels in Portuguese players.

Objectives: This study aimed to examine differences in anthropometric characteristics and physical fitness among trained and highly trained female football players across three age groups.

Methodology: Eighty-six female players from two Portuguese clubs participated and were divided into Under-15 (U15; n=29; 13.8±0.9 years), Under-19 (U19; n=29; 17.1±1.0 years), and Senior (n=28; 21.6±3.1 years) groups. U15 players competed regionally, while U19 and Senior players competed nationally. Assessments included anthropometric measures (height, weight, BMI) and physical performance tests (isometric knee extension and flexion strength, countermovement jump (CMJ), and T-Test). Between-group differences were analysed using Bayesian one-way ANOVA with post hoc pairwise comparisons.

Results: Strong differences were found between Senior and U15 players in body mass (BF10>100), BMI (BF10=26.62), CMJ power (BF10=50.82), T-Test performance (BF10=29.60), and dominant-leg knee flexion strength (BF10=20.39). U19 players recorded the highest knee flexion strength values across all groups, with substantial differences observed against U15 players (BF10>100, for both legs). No meaningful differences were detected in knee extension strength or CMJ height across groups, and no notable distinctions emerged between Senior and U19 players for any variable.

Discussion/Conclusions: These findings suggest that U15 players represent a distinct developmental stage requiring specifically tailored training programs. The superior knee flexion strength in U19 compared to Senior players may indicate a plateau or decline in strength development at the senior level. Overall, these results provide valuable guidance for coaches and technical staff in designing age-appropriate training interventions across the different stages of female football development.

Keywords: Athlete profiling, Youth athletes, Adult athletes, Woman, Soccer

Conflicts of interest: No conflicts of interest declared by the authors.

THE IMPORTANCE OF VISUAL EXPLORATORY BEHAVIOR IN THE MIDFIELD SECTOR AND ITS INFLUENCE ON PASSING IN YOUNG FOOTBALLERS

Catela, F¹, Casanova, F^{1,2}

¹Universidade Lusófona – Centro Universitário do Porto, Porto, Portugal; ²Núcleo de Estudos e Investigação em Futebol (NEIF), Universidade Lusófona, Lisboa, Portugal

*Corresponding author:
+351 919478803
franciscocatela4@gmail.com, filipe.casanova@ulusofona.pt

Introduction: In soccer, the ability to collect visual information before receiving the ball is considered essential for decision-making and technical execution, especially in the midfield.

Objective: To analyze the relationship between visual exploratory behavior (VEB) and passing success in three under-16 players during offensive organization game situations.

Methodology: The sample consisted of 3 players (15.67±0.47 years, 8.0±0.82 years of practice), occupying the positions of defensive pivot (player 1), inside midfielder (player 2), and attacking midfielder (player 3). Data collection was performed by video recording 5 games, with a Sony HDR-CX405 camera (Japan).

Results: Through the use of VEB, midfielders achieved a high pass accuracy rate (with VEB = 74.1 ± 2.89 vs without VEB = 6.6 ± 1.73; p < 0.001). We also found a direct and significant association between VEB and the number of successful passes for each half of the match (1st half: r = 0.828, p < 0.001; 2nd half: r = 0.872, p < 0.001).

Concluding Remarks: Visual exploratory behavior was a key factor in the tactical and technical success of the midfielders' passing, playing a significant role in the accuracy of the young footballer's decision-making.

Keywords: Football, Perceptual-Cognitive Skills, Decision-Making

Conflicts of interest: No conflicts of interest declared by the authors.

A CASE STUDY ON MULTIDISCIPLINARY TEAM DECISIONS: PRE-CONTRACT MEDICAL SCREENING AND RETURN-TO-PERFORMANCE

José Rebelo^{1,2*}, Filipe Real^{1,2}

¹FC Vizela SAD, Unidade Saúde e Performance, Vizela, Portugal; ²FADEUP, Faculdade de Desporto da Universidade do Porto, Portugal

*Corresponding author:

José Rebelo
+351 913190967
drjosemirandarebelo@gmail.com

Introduction: Pre-contract medical screenings are essential for risk stratification. This case examines a professional footballer flagged as high injury risk during these screenings, who sustained a hamstring injury after signing. He played with the diagnosed injury, allowing scrutiny of team decision-making and performance data across different periods.

Objectives: To report the clinical management, performance data, and return-to-play outcomes of a professional footballer with a high injury risk profile who suffered a hamstring injury, highlighting the impact of the decisions made by the player, coach, clinical director and sporting director.

Methodology: A single-subject case study was employed. Data from medical records covered four periods: pre-signing, playing injured, rehabilitation, and post-rehabilitation. Sources included injury history, pre-signing exams, clinical diagnoses, imaging results, physiotherapy logs, conditioning metrics, and GPS data.

Results: Prior to injury, the athlete demonstrated a mean maximum speed of 27.4 km/h (90.1% of peak) and a high intensity distance of 0.76 m/min, establishing the seasonal performance baseline. Despite diagnosis of a hamstring injury, he continued training and competing for seven weeks. Mean maximum speed dropped to 23.3 km/h (71.8% of maximum), and high intensity distance plummeted to 0.05 m/min, reflecting drastic loss of explosive capacity. Following complete stop for treatment into the post-rehabilitation phase his mean maximum speed is 25.2 km/h (77.6% of pre-injury levels), though the initial 32.48 km/h peak remains unreplicated. High intensity distance is 0.34 m/min, a 55% deficit. Total weekly distance progresses at 3.44 km, approaching pre-injury volume.

Conclusions: This case validates pre-signing risk stratification. Allowing a high-risk player to compete through an acute hamstring injury led to sustained deficits in speed and intensity despite clinical clearance. Findings emphasize alignment between medical and coaching departments, because the decisions made by the multidisciplinary team had lasting consequences on player performance.

Keywords: Pre-Participation Screening, Injury, Team decision-making

Conflicts of interest: No conflicts of interest declared by the authors.

WORKLOAD DISTRIBUTION ACROSS MATCHES AND COMPENSATORY SESSIONS ACCORDING TO STARTING STATUS IN HIGHLY TRAINED YOUTH SOCCER PLAYERS

Gonçalo Reis^{1,2*}, Filipe Maia¹, Fabio Nakamura^{1,3}, Sandro Tito^{1,2}

¹Research Centre in Sports Sciences, Health and Sciences and Human Development (CIDESD) / University of Maia (UMAIA); ²Department of Performance Optimization (GOD), Sporting Clube de Braga, Braga, Portugal; ³FSI. Lab, Football Science Institute, Granada, Spain

*Corresponding author:

Gonçalo Reis
+351 918639639
greis.dcd@umaia.pt

Modern football is marked by increasing physical intensity and tactical complexity, raising new challenges for optimal load management. Match-play provides distinct stimuli according to starting status, directly influencing weekly loading patterns. To balance exposure within the group, practitioners implement compensatory training sessions to reproduce match demands. However, recent evidence suggests that match-specific intensities are only partially achieved in these sessions.

As such, this study aimed to examine the workload experienced during match-play and compensatory training sessions according to status, to identify potential disparities and highlight the most pronounced differences. Twenty-nine elite youth soccer players were classified as starters (ST) or non-starters (NST) based on prior match exposure (≥ 60 min). External load was monitored via GPS during field-training sessions and official matches across a full competitive season, with nine workload variables analysed (absolute and relative). A mixed-effects model was applied to assess the effect of condition across both settings while accounting for missing data.

Our findings revealed clear and consistent differences between match-play and compensatory sessions ($p < 0.05$). During match-play, ST consistently presented higher absolute workloads, while NST demonstrated greater relative (per-minute) outputs. During compensatory sessions, NST consistently showed higher workloads across all metrics, partly because the squad was split by starting status. Nevertheless, for several metrics, these increments were modest and therefore insufficient to fully mitigate the diminished match burden in NST, with week-long analysis highlighting persistent loading imbalances. Nonetheless, acknowledging the challenges of replicating competitive conditions, the approach made a limited but positive contribution to the overall load-management strategy.

The observed differences underscore the challenges of replicating competitive demands within training and reinforce the importance of individualized load-management strategies to optimize competitive readiness and sustain sport-specific fitness throughout the season. Broader approaches that better reproduce match stimuli are warranted to promote optimal adaptation and enhance squad resilience across the season.

Keywords: Soccer, Youth, Workload, Top-up, Game-Exposure, Imbalance

Conflicts of interest: No conflicts of interest declared by the authors.

MATCH PHASE INFLUENCES THE LOCOMOTOR COMPOSITION OF PEAK KINEMATIC DEMANDS IN ELITE MALE FOOTBALL

Farzad Yousefian^{1,2}, Alberto Cortez^{2,3}, Bruno Gonçalves^{2,3}, João Brito^{2,4}, Bruno Travassos^{1,2}

¹Department of Sport Sciences, Research Centre in Sports Sciences, Health Sciences and Human Development (CIDESD), University of Beira Interior, Covilhã, Portugal; ²FPF Academy, Portuguese Football Federation, Oeiras, Portugal; ³Department of Sports and Health, School of Health and Human Development, Comprehensive Health Research Centre (CHRC), University of Évora, Évora, Portugal; ⁴Interdisciplinary Center for Human Performance (CIPER), Faculty of Human Kinetics, University of Lisbon, Portugal

*Corresponding author:
Farzad Yousefian
+351 912538169
Farzad.Yousefian@ubi.pt

Introduction: The relationship between the time of occurrence and the most intense period (MIP) demand during match play has predominantly been examined using discrete univariate metrics, providing limited insight into how the compositional structure of locomotor demands may vary during peak match passages.

Objectives: To investigate the influence of match phase (15-min intervals), representing time of occurrence during match play, on multifactorial kinematic MIP external load demands according to relative intensity and constituent variable composition across multiple passage durations.

Methodology: Locomotor data from 494 players across 64 matches of the 2022 FIFA World Cup were obtained using 25Hz TRACAB optical tracking systems. Rolling average analyses across 1-, 3-, and 5-min periods identified the kinematic MIP (MIPk; $\geq 15 \text{ km}\cdot\text{h}^{-1}$), composed of moderate-speed running (MSR), high-speed running (HSR) and sprinting (SPR). MIPk relative intensity ($\text{m}\cdot\text{min}^{-1}$), total passage distance (TD), and the relative proportions of MIPk, MSR, HSR, and SPR were examined across 15-min match intervals using linear mixed-effects models.

Results and discussion: Between the first and final 15-min intervals, TD moderately declined by 7%–10% across 3-min and 5-min passages ($p < 0.05$), alongside compositional shifts in locomotor demands characterized by small-to-moderate declines in %MSR (8–12%) and increases in %HSR (5–13%) and %SPR (3–49%) across all passage durations. Non-significant fluctuations in MIPk ($\text{m}\cdot\text{min}^{-1}$) and %MIPk indicate relatively stable MIPk intensity profiles. Passage duration differentially influenced variable magnitudes, with TD and %MSR increasing while MIPk, %MIPk, %MSR, and %SPR decreased from 1 to 5-min passages.

Conclusions: Match phase significantly influences the compositional structure of peak kinematic demands across durations, whereas relative MIPk intensity remains comparatively stable. These compositional shifts indicate that MIPk passages occurring at different match phases may impose differential external load demands. Recognition of these variations can inform targeted training prescription and load monitoring strategies aligned with MIP specific external load profiles.

Keywords: Peak Demands, Most Intense Period, Elite Football, Relative Intensity, Performance Analysis

Conflicts of interest: No conflicts of interest declared by the authors.

THE PHYSIOLOGICAL, PERCEPTUAL, AND PHYSICAL RESPONSES OF MALE FOOTBALL PLAYERS TO DIFFERENT COOLING BREAK DURATIONS DURING MATCH-PLAY

Catarina B. Oliveira^{1,2*}, Júlio A. Costa², Rafael Lopes^{2,3,4}, Carolina Bastos², Sara Oliveira^{2,5}, Vincent Gouttebauge^{6,7,8}, João Brito^{2,5}

¹Research Centre in Sports Sciences, Health and Sciences and Human Development (CIDESD) / University of Maia (UMAIA); ²Department of Performance Optimization (GOD), Sporting Clube de Braga, Braga, Portugal; ³FSI. Lab, Football Science Institute, Granada, Spain

*Corresponding author:
Gonçalo Reis
+351 918639639
greis.dcd@umaia.pt

Introduction: The IFAB Laws of the Game allows the implementation of 'cooling' breaks during a football match to protect players' health and wellbeing. These breaks usually last 3 minutes; nevertheless, it is stipulated that they can be as short as 90 seconds.

Objectives: The study aimed to assess the feasibility and efficacy of 90-second and 3-minute cooling breaks in a football match played in high temperatures.

Methodology: Seventeen trained male football players [24.0 (3.9) years] played a 90-minute match (with an extended ~20-minute half-time) in hot conditions (ambient temperature, 33.5°C; relative humidity, 32%; Wet Bulb Globe Temperature, 29.1°C). Two cooling break durations were tested: two 90-second breaks (at minutes 15, 30, 60, and 70) and one 3-minute break (at minutes 25 and 70) per half. No additional heat-mitigation strategy applied. Core temperature (T_{core}) was recorded using an ingestible telemetric capsule. Whole-body sweat rate (WBSR), thermal sensation, rating-of-fatigue, rating of perceived exertion, and running performance were additionally monitored. Quantitative variables were analysed using general or generalized linear models, with Bonferroni pairwise comparisons. The Mann-Whitney U test was used for perceptual responses. Data are presented as mean (95% CIs) or median (Q25, Q75).

Results: Peak [38.9°C (38.5–39.3) vs 39.4°C (39.3–39.6), $p = 0.015$] and mean [38.4°C (38.4–38.4) vs 38.9°C (38.8–38.9), $p < 0.001$] T_{core} were lower in the 3-minute group. WBSR was similar between groups. Post-match, the rating-of-fatigue was lower in the 3-minute group [4.0 AU (3.0, 5.0) vs 8.0 AU (7.0, 8.0), $p = 0.035$], despite the higher distance covered in the 90-second group [8955 m (8279–9631) vs 7893 m (6857–8829), $p = 0.046$]. No additional physiological, perceptual, or physical benefits were observed with 90-second cooling breaks per half.

Discussion/Conclusions: Given its feasibility and efficacy, the 3-minute break per half should be recommended over two 90-second breaks in football played in high temperatures.

Keywords: body temperature, football, heat, hot conditions, thermoregulation

Conflicts of interest: CBO, RL, and SO are supported by FCT – Fundação para a Ciência e Tecnologia, I.P., by project references 2022.14442.BD, 2023.03718.BDANA, and 2024.00634.BDANA, respectively. For the remaining authors none were declared.

THE EFFECTS OF PLAYING SURFACE ON EXTERNAL LOAD PARAMETERS IN PROFESSIONAL FOOTBALL PLAYERS: ARTIFICIAL VERSUS NATURAL GRASS

Thor Sigurdsson¹, Tomás T. Freitas^{1,2,3}, Konstantinos Spyrou^{1,2}

¹UCAM Research Center for High Performance Sport, UCAM Universidad Católica de Murcia, Murcia, Spain; ²Facultad de Deporte, UCAM Universidad Católica de Murcia, Murcia, Spain; ³NAR Nucleus of High Performance in Sport, São Paulo, Brazil

*Corresponding author:
Thor Sigurdsson
+34 678046599
tsigurdsson@alu.ucam.edu

Introduction: The aim of this study was to compare external load parameters of matches played on artificial grass (AG) and natural grass (NG) in professional football players.

Methodology: A total of 51 matches (3rd generation AG, n=37; NG, n=19) were used to compare the external load data of the two surfaces across four consecutive seasons (2022–2025). Global Positioning System (GPS) data from 26 male players from the same team, who played >80 minutes in an official match and competed in both surfaces were collected. The following variables were analyzed per minute of playing time: total distance (TD), running (RUN), high-speed running (HSR), sprinting (SPR), and the total number of moderate-, and high-intensity accelerations (ACC), decelerations (DEC). A linear mixed model analysis was conducted to identify differences between the two surfaces.

Results: The results indicated that players performed more TD, RUN, HSR, and SPR ($p < 0.001$ – 0.013 ; ES: 0.22–0.44) on AG compared to NG. Likewise, higher total, and moderate- and high-intensity ACCs and DECs ($p = 0.001$ – 0.012 ; ES: 0.06–0.31) were completed on AG when compared to NG.

Conclusion: In conclusion, players experienced more external load in AG when compared to NG. However, it is important to highlight that the magnitude of the differences was trivial to low. Thus, from a practical standpoint, it could be argued that playing surface has little influence on match-play demands in professional football.

Keywords: Soccer, physical demands, surface, external load, team sports

Conflicts of interest: No conflicts of interest declared by the authors.

EXTERNAL LOAD QUANTIFICATION OF PROFESSIONAL WOMEN SOCCER PLAYERS

Renato Fernandes^{1,2*}, João Paulo Brito^{1,2,3}, Mário C. Espada^{5,6,7,8,9}, Fernando J. Santos^{5,6,10}, Sara Branco^{2,3,11}, Matilde Nalha¹, Ryland Morgans⁴, Rafael Oliveira^{1,2,3}

¹Santarém Polytechnic University, School of Sport, Av. Dr. Mário Soares, 2040–413 Rio Maior, Portugal; jbrito@esdrm.ipsantarem.pt (J.P.B.); rfernandes@esdrm.ipsantarem.pt (R.F.); ²Life Quality Research Centre (CIEQV), Santarém Polytechnic University, Av. Dr. Mário Soares, 2040–413 Rio Maior, Portugal; ³Research Center in Sport Sciences, Health Sciences and Human Development (CIDESD), Covilhã, Portugal; ⁴School of Sport and Health Sciences, Cardiff Metropolitan University, Cardiff CF23 6XD, UK; rmorgans@cardiffmet.ac.uk (R.M.); ⁵Life Quality Research Centre (CIEQV-IP Setúbal), Campus do IPS – Estefanilha, 2910–761 Setúbal, Portugal; fernando.santos@ese.ips.pt (F.J.S.); ⁶Instituto Politécnico de Setúbal, Escola Superior de Educação, 2914–504 Setúbal, Portugal; ⁷Interdisciplinary Centre for the Study of Human Performance (CIPER), Faculdade de Motricidade Humana, Universidade de Lisboa, 1499–002 Lisbon, Portugal; ⁸SPRINT Sport Physical Activity and Health Research & Innovation Center / Centro de Investigação e Inovação em Desporto Atividade Física e Saúde. 2040–413 Rio Maior, Portugal; ⁹Comprehensive Health Research Centre (CHRC), Universidade de Évora, 7004–516 Évora, Portugal; mario.espada@ese.ips.pt (M.C.E.); ¹⁰Faculdade de Motricidade Humana, Universidade de Lisboa, 1499–002 Lisbon, Portugal; ¹¹Department of Sports Sciences, University of Beira Interior, Covilhã, Portugal

*Corresponding author:
Renato Fernandes
+351 966470802
rfernandes@esdrm.ipsantarem.pt

The aim of this study was to quantify the external load of the typical microcycle from a professional Portuguese female soccer players during the 20/21 in-season, using the match-day minus (MD-) approach. Ten players (24.7 ± 2.6 years), 100 training sessions and 10 matches were analysed. The following measures were analysed in absolute or relativized per minute: duration, distance, high-speed running distance (HSR, >15 km/h), number in different accelerations and decelerations zones. Total distance showed a significant difference between MD-4 and MD-2 ($p = 0.047$) which presented the lowest value of all microcycle days, while MD presented the highest value of HSR than all training days ($p = 0.001$). ACC1 (>1–2 m.s⁻²) showed significant higher values for MD-5 than MD-2 ($p = 0.011$) and for MD than MD-2 ($p = 0.002$). ACC2 (>2–3 m.s⁻²) showed significant higher values for MD-4 than MD-2 ($p = 0.002$) and for MD than MD-2 ($p = 0.003$). ACC3 (>3–4 m.s⁻²) showed significant higher values for MD-5 than MD-3 ($p = 0.037$) and for MD than MD-3 ($p = 0.047$). DEC1 (< 1–2 m.s⁻²) showed significant lower value for MD-2 than MD-5 ($p = 0.002$), than MD-4 ($p = 0.015$) and than MD ($p < 0.001$). DEC2 (< 2–3 m.s⁻²) showed significant higher values for MD-4 than MD-2 ($p = 0.001$). DEC3 (< 3–4 m.s⁻²) showed significant lower values for MD-2 than MD-4 ($p = 0.024$) and than MD-3 ($p = 0.009$). DEC4 (< 4 m.s⁻²) showed significant lower value for MD-2 than MD-4 ($p = 0.007$). This study confirmed the highest intensity values during MD and the lowest on MD-2. Moreover, identical values were found in MD-5, MD-4 and MD for total distance and all ACC and DEC metrics while only HSR presented the highest level on MD.

Keywords: acceleration, deceleration, female, football, training load

Conflicts of interest: No conflicts of interest declared by the authors.

MACHINE LEARNING-BASED CHARACTERIZATION OF SHOT OPPORTUNITIES IN THE MOST DEMANDING PASSAGES IN ELITE SOCCER

Alberto Cortez^{1,2,3}, Farzad Yousefian^{3,4}, Hugo Folgado^{1,2}, João Brito³, Diogo Coutinho^{5,6}, Bruno Travassos^{3,4}, Bruno Gonçalves^{1,2,3}

¹Universidade de Évora, Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde, Évora, Portugal; ²Universidade de Évora, Comprehensive Health Research Centre (CHRC), Évora, Portugal; ³FPF Academy, Portuguese Football Federation, Oeiras, Portugal; ⁴Research Centre in Sports Sciences, Health Sciences and Human Development (CIDESD), Department of Sport Sciences, University of Beira Interior, Covilhã, Portugal; ⁵Research Centre in Sports Sciences, Health Sciences and Human Development (CIDESD), Elite Research Community, Vila Real, Portugal; ⁶Department of Sports Sciences and Physical Education, University of Maia, 4475-690 Maia, Portugal

*Corresponding author:
Alberto Cortez
+351 915350909
alberto.v.cortez@protonmail.com

Introduction: This study examined the physical, tactical, and technical performance associated with the most demanding passages of kinematic activity (MDPk) that ended with shots on goal in elite soccer.

Methods: The MDPk (≥ 15 km/h) was calculated using rolling average windows of 1 minute ($n = 1023$ observations). Logistic regression analysis was conducted to identify the variables most strongly linked to the probability of a shot occurring during MDPk, considering three physical, nine tactical, and three technical performance indicators. Variables were retained based on statistically significant odds ratios ($p < 0.05$), with results varying by playing position. Machine learning models (KNN, Decision Tree, and XGBoost) validated the strong predictive capacity.

Results and Discussion: The results display a positively influenced central defenders for Spatial exploration index, suggesting that greater spatial exploration facilitates offensive progression and shot generation. Conversely, percentage of time spent in the own third had a negative impact on the shot opportunity, suggesting the need for these players to search for positions closer to the opponent's goal. The percentage of ball-in-play negatively influenced central defenders, full-backs, central midfielders and center forwards, indicating that shot-related MDP were more likely to occur following ball-out-of-play situations.

Conclusions: These findings reveal clear positional differences and emphasize the role of spatial behavior and tactical transitions originating from static or restarted phases. The study provides practical insights for designing position-specific training tasks that integrate physical, technical, and tactical components, with the aim of improving shot occurrence during these high intensity moments of competition.

Keywords: Association Football, Peak Periods, Offensive Performance, Logistic Regression, Predictive Modelling

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DOES EXTERNAL LOAD INFLUENCE SLEEP METRICS IN FOOTBALL PLAYERS?

Lúcio Cunha¹, João Brito², Michelle Lastella³, Pedro Figueiredo⁴

¹Research Center in Sports Sciences, Health Sciences and Human Development, CIDESD, University of Maia, Maia, Portugal; ²FPF Academy, Portuguese Football Federation, Oeiras, Portugal; ³Appleton Institute for Behavioural Science, Central Queensland University, Adelaide, Australia; ⁴Physical Education Department, College of Education, United Arab Emirates University, Al Ain, Abu Dhabi, United Arab Emirates

*Corresponding author:
Lúcio Cunha
+351 913288254
luciocunha95@hotmail.com

Introduction: Fluctuations in daily training/match loads can significantly affect recovery markers, with sleep being a critical variable in this process.

Objectives: This observational study examined sleep differences between microcycle days with low, medium and high external loads in adult football players.

Methods: The study included 52 adult football players (aged 23.1 ± 4.4 years, 33 female). For two weeks, the players wore a 3-axial accelerometer on the wrist during sleep and a 10-Hz GPS device in all training sessions and matches. The variable total distance was used to categorize days as low, medium, or high external load ($<50\%$, $50-80\%$ and $>80\%$ of the player's maximum value, respectively). Linear mixed models were used to examine the differences in sleep duration, efficiency, latency and wake after sleep onset (WASO) between days with low, medium, and high loads.

Results: On low load days ($n=90$), players covered 3417 m (95% CI: 3170-3664), slept 6h 44min (95% CI: 6h 26min - 7h 02min), had a sleep efficiency of 84.4% (95% CI: 82.3-86.4%), a latency of 8 min (95% CI: 4-11), and a WASO of 65 min (95% CI: 56-76). On medium load days ($n=142$), players covered 5368 m (95% CI: 5218-5518), slept 6h 40min (95% CI: 6h 23min - 6h 56min), had a sleep efficiency of 84.4% (95% CI: 82.5-86.4%), a latency of 9 min (95% CI: 6-12), and a WASO of 66 min (95% CI: 56-75). On high load days ($n=90$), players covered 7409 m (95% CI: 7062-7756), slept 6h 41min (95% CI: 6h 24min - 6h 59min), had a sleep efficiency of 84.2% (95% CI: 82.3-86.1%), a latency of 9 min (95% CI: 6-12), and a WASO of 68 min (95% CI: 58-77). No significant differences were observed across training load categories for any of the sleep variables ($p > 0.05$).

Conclusion: In conclusion, sleep metrics remained stable regardless of external load magnitude. These findings indicate that acute increases in training load do not change sleep quality or duration, implying that other factors beyond workload may be more decisive drivers of sleep disturbances in football.

Keywords: sleep, training loads, football

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PRE-MATCH EMOTIONAL STATES IN THE FIFA FUTSAL WOMEN'S WORLD CUP FINALISTS

Rute Carvalho^{1,2,3}, Andreia Teixeira¹, Bruno Travassos^{2,3,4}, Jaime Sampaio^{1,2}, Júlio Costa³

¹University of Trás-os-Montes and Alto Douro, Vila Real, Department of Sports Science, Exercise and Health, Vila Real, Portugal; ²CIDESD - Research Center in Sports Sciences, Health Sciences, and Human Development, Portugal; ³FPF Academy, Portuguese Football Federation, Oeiras, Portugal; ⁴Department of Sports Sciences, University of Beira Interior, Covilhã, Portugal

*Corresponding author:
Rute Carvalho
+351 936367565
rute Carvalho@utad.pt

Introduction: Pre-competitive emotional states, including basic emotions and affective states (valence and arousal), critically influence sport performance, yet collective emotional profiles in high-stakes female team sports remain underexplored. This study examined the emotional profiles of Brazil (World-Champion) and Portugal (Runner-up) during the pre-match ceremony (team line-up (LU) and national anthem (NA)) of six matches across all competitive phases of the FIFA Futsal Women's World Cup.

Methods: Video footage of LU and NA was analyzed using FaceReader, which extracted frame-by-frame emotional intensities of six basic emotions, emotional valence and arousal. Collective emotional profiles were computed per competitive phase, and longitudinal drifts were examined per. Statistical analysis included Wilcoxon signed-rank tests, Mann-Whitney U tests, and Spearman rank correlations. All analyses were conducted in R software.

Results: In Brazil, NA increased arousal (G2-Final: $p < .001$), fear (G1, G3, QF, SF: $.002 \leq p \leq .047$) and surprise (QF, SF: $p < .001$), whereas happiness (G3, SF: $p < .001$) and disgust (G1, G2, Final: $.004 \leq p \leq .011$) were higher during LU. Portugal exhibited increased arousal (G1-G3, SF, Final: $.001 \leq p \leq .013$) and surprise ($.002 \leq p \leq .001$) during NA, while LU elicited anger, happiness, fear, and sadness. Between teams, Brazil showed higher valence ($.011 \leq p \leq .001$) and a progressive decrease in arousal, whereas Portugal exhibited higher arousal ($.003 \leq p \leq .001$) and emotional stability across phases.

Discussion/Conclusion: NA elicited higher arousal and surprise than LU, probably acting as a key affective trigger. Brazil's adaptive emotional regulation, marked by decreasing arousal and higher valence, may have contributed to their championship performance. In opposition, Portugal's demonstrated elevated arousal over the matches. Future studies should directly link pre-competitive emotional profiles to performance outcomes.

Keywords: FIFA Futsal Women's World Cup, Emotional States, Emotional Expression

Conflicts of interest: No conflicts of interest declared by the authors.

CONCURRENT VALIDITY OF LEAP AND WGT3X ACTIGRAPH ACCELEROMETERS DURING WALKING FOOTBALL ACTIVITY IN OLDER ADULTS

Francisco Estima¹; Gustavo Silva¹; Luísa Aires²; Ana Carvalhinho Silva¹; André Seabra³; Júlio A. Costa³

¹CIDESD, University of Maia (UMaia), Portugal; ²CIAFEL, Faculty of Sport, University of Porto, Portugal; ³FPF Academy, Portuguese Football Federation, Oeiras, Portugal

*Corresponding author:
Francisco Estima
+351 966361049
festima.dcd@umaia.pt

Introduction: Wrist-worn accelerometers offer greater comfort and compliance than hip-worn devices, but their concurrent validity in specific sports contexts remains underexplored.

Purpose: This study aimed to analyse the concurrent validity of the LEAP ActiGraph accelerometer in older men during a walking football activity.

Methods: Fourteen participants wore a LEAP ActiGraph accelerometer on the wrist and a wGT3X (reference) on the waist during a 300-minute monitoring period that included a walking football tournament with one to four matches. Raw data from both devices were reduced to 1-minute epoch files. For the LEAP, total activity was quantified using Euclidean Norm Minus One (ENMO, mg) and physical activity (PA) intensities classified using Hildebrand cut-points. For the wGT3X, a vector magnitude was calculated from triaxial counts and PA intensities classified using Troiano cut-points. Paired-samples t-tests compared time in each physical PA intensity between devices, and agreement was assessed using Intraclass Correlation Coefficients (ICC). All analyses were performed in SPSS v.29 ($p < 0.05$).

Results: Compared with the wGT3X, the LEAP overestimated sedentary time (57.6 ± 29.3 min) and underestimated time in moderate (-16.7 ± 13.2 min), vigorous (-46.7 ± 12.3 min), and MVPA (-63.4 ± 10.0 min). ICC varied across intensities: sedentary (ICC = -0.131 , poor), light (ICC = -0.338 , poor), moderate (ICC = -0.048 , poor), vigorous (ICC = 0.578 , moderate), and MVPA (ICC = 0.824 , good).

Discussion/Conclusions: The LEAP showed limited agreement with the wGT3X for most PA intensities, particularly sedentary, light, and moderate. Negative ICC values for lower intensities reflect high between-minute variability relative to between-subject differences, a known limitation when comparing devices with distinct cut-point systems. Moderate-to-good agreement was observed for vigorous activity and MVPA. These findings suggest the LEAP may not be interchangeable with the wGT3X for detailed intensity classification in older adults, though it may provide acceptable estimates for higher-intensity PA.

Keywords: Accelerometry, Concurrent validity, Walking football, Physical activity intensity, Older adults, Wrist-worn accelerometer

Conflicts of interest: No conflicts of interest declared by the authors.

THE RELATIONSHIP BETWEEN AEROBIC AND ANAEROBIC LOAD IN TRAINING AND COMPETITION IN SENIOR WOMEN'S FOOTBALL

Tiago Castro¹, Pedro Fatela²

Faculdade de Motricidade Humana

*Corresponding author:

Tiago Castro
+351 919283330
tiago.castro10.tr@gmail.com

Introduction: Female senior football has undergone remarkable physiological and tactical evolution, demanding a deeper understanding of how training load relates to competitive demands. This study aimed to analyse the aerobic and anaerobic load relationship between training sessions and competition across a full competitive season in a senior female football team, assessing whether the periodization practiced adequately replicates the demands of match play.

Methods: An observational retrospective study was conducted with 24 female players competing in the Portuguese 2nd National Division during the 2023/2024 season. External load data from 73 training sessions and 22 official matches were collected using GNSS/GPS devices. Aerobic and anaerobic distances were classified using individual Second Ventilatory Threshold (VT2) values, determined through a maximal incremental treadmill test. Linear Mixed Models (LMM) were used for statistical analysis, with Bonferroni correction applied for multiple comparisons ($\alpha = 0.05$).

Results: The microcycle followed an inverted U-shaped structure, with total distance peaking at MD-3 (4768.7 m) and tapering at MD-2 (3204.6 m). The game imposed significantly greater demands across all metrics, including total distance (5859.6 m), intensity ($128.5 \text{ m}\cdot\text{min}^{-1}$), anaerobic distance (266.19 m; 4.5%), and sprint distance (66.96 m) compared to all training sessions. MD-3 emerged as the closest approximation to match demands in absolute terms, while MD-2 presented the energy composition ratio (96.6% aerobic vs. 3.4% anaerobic) most structurally like the game (95.5% vs. 4.5%). ACC+DCC was the only metric where training broadly replicated match levels, whereas sprint distance was the most critically underrepresented variable throughout the microcycle, never exceeding 50% of competitive demand.

Conclusion: The current periodization effectively develops aerobic base but systematically underexposes athletes to the glycolytic peaks and temporal density characteristic of competition. Reconfiguring MD-3 to include VT2-oriented anaerobic blocks, planning compensatory sessions for non-starters, and implementing individualized multimodal monitoring are recommended to close the gap between training and competitive demands.

Keywords: female football, training load, competition, aerobic, anaerobic, GPS, microcycle, VT2, periodization

Conflicts of interest: No conflicts of interest declared by the authors.

IMPACT OF MD+2 TRAINING ON INTERNAL AND EXTERNAL LOAD IN MD-4: DIFFERENCES BETWEEN STARTERS AND NON-STARTERS IN ELITE YOUTH FOOTBALL

Hugo Ferreira^{1*}, Pedro Quiaios²

Futebol Clube Paços de Ferreira - High Performance Office CASTOR LAB

*Corresponding author:

Hugo Ferreira
+351 910820543
hugofilipe.silva.ferreira@gmail.com

Introduction: Monitoring internal and external load is essential in elite football. Within the microcycle, MD-4 and MD+2 present different demands, while starters and non-starters may experience different training stimuli.

Objectives: This study aimed to compare internal and external training load between MD+2 and MD-4 sessions and to analyse differences between starters and non-starters in an elite under-19 football team across multiple microcycles.

Methodology: The training load of 30 football players (18.1 ± 0.7 years old; 175.4 ± 5.2 cm in height; 71.8 ± 5.3 kg in weight) from an elite under-19 team (FC Paços de Ferreira) was analysed across eight microcycles, including eight MD+2 and eight MD-4 training sessions. External load variables, including total distance (m), accelerations and decelerations ($>2 \text{ m/s}^2$), high-speed running distance ($>19.8 \text{ km/h}$), and Player Load, were obtained using GPS devices, while internal load was assessed using session-RPE. Training sessions were classified as active recovery (MD+2) and strength-oriented session (MD-4). Differences between sessions and between starters and non-starters were analysed using repeated measures ANOVA in Jamovi.

Results and Discussion: As expected, significant differences were observed between MD+2 and MD-4 sessions for all variables, regardless of whether players were starters or non-starters. In MD-4, no significant differences were found between starters and non-starters for external load variables ($p > 0.05$). However, significant differences were observed in internal load, with non-starters showing higher RPE values ($p = 0.022$).

Conclusions: No differences were observed in external training load between starters and non-starters in MD-4, whereas significant differences were found in internal load, with non-starters reporting higher RPE values. These findings suggest that the higher training load typically imposed on non-starters in MD+2 may influence their subsequent internal load responses in MD-4, without affecting external load variables.

Keywords: Training Load, Starters vs Non-Starters, Microcycle, Internal Load, External Load

Conflicts of interest: No conflicts of interest declared by the authors.

GOAL CLASSIFICATION AS A FUNCTION OF THE NUMBER OF TOUCHES PERFORMED PRIOR TO FINISHING IN ELITE FUTSAL

Afonso Diniz^{1*}, André Seabra², Rui Paulo^{3,4}, Élvio R. Gouveia^{5,6}, Hugo Sarmento^{7,8}

¹Faculdade de Motricidade Humana, Universidade de Lisboa, Portugal; ²Portugal Football School, Portuguese Football Federation, FPF, Oeiras, Portugal; ³Polytechnic University of Castelo Branco; ⁴SPRINT – Sport Physical Activity and Health Research & Innovation Center; ⁵Department of Physical Education and Sport, University of Madeira, Funchal, Portugal; ⁶Interactive Technologies Institute, LARSYS, Funchal, Portugal; ⁷Universidade de Coimbra, CIPER, Faculdade de Ciências do Desporto e Educação Física, Coimbra, Portugal; ⁸Faculdade de Educação Física e Ciências do Desporto, Universidade de Coimbra, Coimbra, Portugal

*Corresponding author:
Afonso Diniz
+351 912187113
afonso.n.c.diniz@gmail.com

Elite futsal is characterised by high intensity, rapid execution, and high tactical demands, factors that constrain the time available for decision-making and technical execution in offensive situations. In this context, immediate finishing after receiving the ball has been suggested as a potentially effective solution. However, its actual incidence in elite futsal remains underexplored. Thus, this study aimed to analyse goal classification based on the number of touches before finishing, comparing first-touch goals with goals scored after multiple touches.

The investigation relied on the systematic observation of the seven final matches of the Portuguese Futsal League Cup in the 2024/2025 and 2025/2026 seasons. Data collection was conducted via video analysis using the LongoMatch software, with goals classified solely by the number of touches before the shot. Differences between finishing types were analysed using the Chi-square test.

In the 2024/2025 season, 48 goals were analysed, of which 29 (60.4%) resulted from first-touch finishes and 19 (39.6%) from finishes after multiple touches. Despite the higher descriptive frequency of first-touch goals, the Chi-square test did not reveal statistically significant differences between the two classifications ($\chi^2 = 2.083$; $p = 0.149$). In the 2025/2026 season, 39 goals were analysed: 27 (69.2%) were scored at first touch and 12 (30.8%) after multiple touches. In this edition of the competition, the Chi-square test revealed statistically significant differences between finishing types ($\chi^2 = 5.769$; $p = 0.016$).

The results indicate that although first-touch finishing occurs more frequently in elite futsal, its statistical predominance may vary across competitive contexts. These findings suggest that finishing success is not determined exclusively by the number of touches before the shot. Future research integrating contextual variables and larger samples is recommended to understand further the factors influencing offensive effectiveness in elite futsal.

Keywords: offensive performance, decision-making, elite performance, match analysis

Conflicts of interest: No conflicts of interest declared by the authors.

PASS2FORMATION: MULTI-RECEIVER, FULL-TEAM NEXT-LOCATION FORECASTING FROM SHORT EVENT SEQUENCES IN FOOTBALL

Mikhail Abdelmalak*, Tamer Basha

Faculty of Engineering, Cairo University, Egypt

*Corresponding author:
Mikhail Abdelmalak
+20 1092770461
m.daoud@eng.cu.edu.eg

Introduction: Predicting player locations immediately after a pass in football is a challenging multi-agent problem, as existing approaches primarily focus on isolated components such as action valuation (e.g., Expected Possession Value, VAEP), pass success probability (xPass), or receiver prediction, without modeling the full-team spatial reorganization following a pass.

Objectives: This study aims to develop a model capable of forecasting the complete post-pass spatial configuration of all 22 players and enabling deterministic evaluation of multiple receiver scenarios for tactical analysis.

Methodology: We propose Pass2Formation, a sequence-to-next-state framework based on a two-layer Long Short-Term Memory (LSTM) architecture) with batch normalization and dropout. The model takes as input four prior pass events (features per event, including player and ball positions and contextual pass features) and predicts the next-event locations of all 22 players. The model is trained and evaluated using the publicly available PFF FC 2022 FIFA World Cup dataset. A baseline model is trained on 37 matches and fine-tuned on 27 matches involving France, Argentina, Morocco, Croatia, and England. A matrix-style evaluation (Mean Absolute Error (MAE)) is conducted to assess both within-team specialization and cross-team generalization. In addition, detailed analyses are performed across player roles, match periods, pass characteristics, and team spatial dispersion.

Results and Discussion/Conclusions: The baseline model achieves an MAE of 6.8 m, improving to 5.6 m after team-specific fine-tuning, with error reductions of up to 39% (England). Cross-team evaluation reveals sensitivity to tactical variability, while detailed analysis indicates lower errors for low-mobility roles (e.g., goalkeepers and defenders), reduced team dispersion, and during the first and second match periods, in contrast to extra time periods, which show greater variability in team formations. The model also generates coherent full-team formations for alternative receiver choices, enabling counterfactual scenario analysis. Pass2Formation provides a practical and efficient framework for tactical analysis, scenario evaluation, and football simulation.

Keywords: Football Analytics, Spatiotemporal Modeling, Multi-Agent Systems, Deep Learning, Tactical Analysis, Soccer Simulation

Conflicts of interest: No conflicts of interest.

PERFORMANCE DIFFERENCES BETWEEN ADULT AND U-19 PROFESSIONAL GOALKEEPERS IN A VIRTUAL REALITY GOALKEEPER TASK

Ana C Paludo^{1*}, Koulla Parpa², Marcos Michaelides², Marios Avraamides^{1,3}

¹Department of Psychology, University of Cyprus, Nicosia, Cyprus; ²Faculty of Sport and Exercise Science, UCLan University of Cyprus, Pyla, Cyprus; ³CYENS Centre of Excellence, Nicosia, Cyprus

*Corresponding author:
Ana C Paludo
+357 94 337878
paludo.ana@ucy.ac.cy

Introduction: Goalkeepers rely on perceptual-motor abilities to respond to high-speed game situations. If these abilities are developed with sport-specific experience, age-related differences in performance should be present. In this study, we tackle this question using Virtual Reality (VR), through which we can get an objective and ecologically valid measure of goalkeeping performance.

Objective: To investigate potential differences in perceptual-motor abilities between adult and U-19 professional goalkeepers by examining their performance during a highly-demanding VR task.
Methodology: Eighteen male goalkeepers from three professional clubs in Cyprus were divided into adults (n = 9; 26.4 ± 5.61 years) and U-19 (n = 9; 16.7 ± 0.87 years). Participants performed a VR task requiring responses with the hands to 60 balls projected at very high velocity from three virtual cannons with randomized frequencies (intervals ranging from 0.6 to 3.0s). The task was carried out in a Meta Quest® head-mounted-display and involved a scenario from the VkeepR app (Mentis VR®). Performance outcomes included ball blocked and accuracy (percentage of successful saves). Group comparisons were performed using delta percentage and effect size (Cohen's d).

Results: Adult goalkeepers demonstrated higher performance compared to U-19 players. The number of balls blocked was 24.9 ± 6.5 in adults and 21.9 ± 2.1 in U-19 players. Accuracy values were 41.5 ± 10.8% and 36.5 ± 10.5%, respectively. The effect size for group differences was moderate (d = 0.47). Delta percentage analysis indicated that adult goalkeepers achieved approximately 12% greater accuracy than their U-19 counterparts.

Conclusion: Adult professional goalkeepers exhibited superior accuracy in the highly-demanding VR goalkeeping task compared to U-19 players. This result suggests that VR task can capture individual differences in goalkeeping performance across age groups. Thus, it could be used to provide valid and valuable insights into goalkeeper development and support individualized training strategies.

Keywords: Goalkeeper, cognitive-motor, virtual reality, soccer

Conflicts of interest: No conflicts of interest declared by the authors.

DOES SCORING FIRST MATTER? MATCH DYNAMICS IN ELITE WOMEN'S FUTSAL

José Manuel Hurtado Ollero^{1*}, Pablo López Sierra¹, Sergio Ibáñez Godoy¹

¹Facultad de Ciencias de la Actividad Física y el Deporte, Universidad de Extremadura, España

*Corresponding author:
José Manuel Hurtado Ollero
+34 681112518
josehurtado@unex.es

Introduction: Scoring first has consistently been identified as a relevant performance indicator in team sports, as taking the lead often changes tactical behaviour and increases the likelihood of success. Although this effect has been widely reported in sports such as football and basketball, evidence in elite women's futsal is still limited, particularly regarding its interaction with contextual and competitive variables.

Objectives: To analyse the influence of scoring first on halftime and final match outcomes in elite women's futsal, and to examine how this effect interacts with team competitive level, match location, and timing of the first goal.

Methodology: Eighty team-match observations from 40 matches in the Spanish Women's First Division were analysed, considering the team as the unit of analysis. Associations between first-goal status and match outcomes were examined through contingency tables, Chi-square tests, and Cramer's V. In addition, a CHAID classification tree was applied to explore the hierarchical interaction among first-goal status, team competitive level, match location, timing of the first goal, and final result.
Results and Discussion: Scoring first showed a strong association with halftime result and a moderate-to-strong association with final outcome. Teams that scored first won 72.5% of matches, whereas those conceding first won only 22.5%. The classification tree identified first-goal status as the main predictor of final result, followed by team competitive level, defining distinct outcome profiles. These findings suggest that scoring first is not only linked to immediate competitive advantage, but also acts as a structural factor that shapes match dynamics from the early stages of play, especially when combined with differences in competitive level.

Conclusions: Scoring first substantially increases the probability of success in elite women's futsal. Its influence is evident at halftime and persists until the end of the match, reinforcing its value as a key performance indicator.

Keywords: first goal, scoring first effect, match status, futsal, performance analysis, classification tree

Conflicts of interest: No conflicts of interest declared by the authors.

TASK-SPECIFIC EXTERNAL LOAD QUANTIFICATION IN A FEMALE SOCCER GOALKEEPER: A NOVEL PERFORMANCE-BASED APPROACH

Pablo López-Sierra^{1*}, Inés García-Augustin¹, José Manuel Hurtado-Ollero¹, Sergio J. Ibáñez¹

¹Grupo de Optimización del Entrenamiento y el Rendimiento Deportivo (GOERD), Facultad de Ciencias del Deporte, Universidad de Extremadura, 10003, Cáceres, España

*Corresponding author:

Pablo López-Sierra
+34 608929580
pablols@unex.es

Introduction: External load monitoring in soccer has traditionally relied on locomotor variables (e.g., distance, speed), which are not representative of goalkeeper (GK) performance. The absence of task-specific metrics limits ecological validity when analysing GK demands.

Objectives: To quantify and compare task-specific external load in a female soccer goalkeeper across different training and competition contexts.

Methodology: A single-subject observational design was conducted on a competitive female goalkeeper in Spain across 39 sessions. Data were collected in four task conditions: GK-specific tasks (GK task), small-sided games in numerical inequality (SSGi), small-sided games in numerical equality (SSGe), and full game. Variables included stance time, dive frequency and typology, GK load, dive load, and impacts. Descriptive statistics (mean, SD) were calculated, and between-task differences were analysed using Welch's ANOVA ($p < 0.05$).

Results and Discussion: GK task showed the highest dive frequency (1.44 ± 1.26 dives·min⁻¹), clearly exceeding SSGi (0.44 ± 0.42), SSGe (0.34 ± 0.42), and Full Game (0.05 ± 0.06). ANOVA confirmed significant differences in dives/min ($F=32.77$, $p < 0.001$). Dive-related variables (right, left, take-off and landing typologies) were consistently higher in GK task ($p < 0.001$). In contrast, GK load/min did not significantly differ between conditions ($p=0.067$), suggesting limited sensitivity of global load metrics. Full Game presented the lowest exposure to GK-specific actions (impacts: 3.07 ± 3.57 ; dives/min: 0.05 ± 0.06), indicating a mismatch between training and match demands.

Conclusions: Task-specific metrics reveal substantial differences in goalkeeper demands not captured by traditional load indicators. GK-specific training elicits greater technical and neuromuscular demands than both small-sided games (regardless of numerical configuration) and match play. These findings support the inclusion of action-based metrics for accurate GK load monitoring and training optimisation.

Keywords: Goalkeeper performance, External load monitoring, Small-sided games, Task-specific demands, Soccer training

Conflicts of interest: No conflicts of interest declared by the authors.

ACUTE EFFECTS OF THE CHRISTMAS BREAK ON THE PHYSICAL CAPACITIES OF FOOTBALL PLAYERS – AN ECOLOGICAL PERSPECTIVE

João G. Saldanha^{1,2,3*}, Francisco Santos^{1,2,5}, Diogo V. Martinho^{3,4}, Hugo Sarmento^{3,4}, Adilson Marques^{4,5}, Pedro Campos^{6,7}, Krzysztof Przednowek⁸, Élvio R. Gouveia^{1,2,4,9}

¹Department of Physical Education and Sport, University of Madeira, 9020-105 Funchal, Portugal; ²LARSYS, Interactive Technologies Institute, 9020-105 Funchal, Portugal; ³Universidade de Coimbra, CIPER, Faculdade de Ciências do Desporto e Educação Física, Coimbra, Portugal; ⁴CIPER, Faculdade de Motricidade Humana, Universidade de Lisboa, Cruz-Quebrada-Dafundo, Portugal; ⁵ISAMB, Faculdade de Medicina, Universidade de Lisboa, Lisboa, Portugal; ⁶Department of Informatics Engineering and Interactive Media Design, University of Madeira, Funchal, Portugal; ⁷Wowsystems Informática Lda, Funchal, Portugal; ⁸Faculty of Physical Culture Sciences, Medical College, University of Rzeszów, Rzeszów, Poland; ⁹Swiss Center of Expertise in Life Course Research LIVES, 1227 Carouge, Switzerland

*Corresponding author:

João G. Saldanha
+351 969955740
guilhermesaldanha27@gmail.com

Introduction: Short-term detraining periods frequently occur during competitive football seasons. However, limited evidence exists on how brief in-season breaks influence acute changes in physical performance under ecological settings.

Objectives: This study examined the acute effects of a mid-season break on repeated sprinting ability, body composition, maximal strength, and vertical jump performance in semi-professional football players.

Methodology: Seventeen to twenty-one semi-professional male football players were assessed before and after a 5-day training cessation during the Christmas break. Repeated sprint ability was evaluated using the Running Anaerobic Sprint Test (RAST), complemented by measurements of body composition (bioimpedance), vertical jump performance (countermovement and squat jumps), and maximum thigh adduction and abduction strength (portable dynamometry). Descriptive statistics, paired t-tests, and effect size calculations were performed, and intra-individual differences were graphically visualised.

Results and Discussion: Following the break, RAST performance deteriorated significantly. Total RAST time increased by 1.0 s ($p = 0.009$, $d = 0.634$), peak power decreased by 55 watts ($p = 0.049$, $d = -0.427$), and maximum speed declined by $0.65 \text{ km}\cdot\text{h}^{-1}$ ($p = 0.030$, $d = -0.489$), indicating small-to-moderate effect sizes. These impairments suggest that anaerobic and sprint capacity are particularly sensitive to short-term detraining, in line with previous in-season break data. Vertical jump performance showed trivial, non-significant gains, while body composition and thigh strength remained relatively stable, suggesting resilience of these domains over a 5-day interval.

Conclusions: This observational study indicates that a 5-day in-season break may selectively impair anaerobic and sprint performance while preserving strength and neuromuscular power in semi-professional football players. Practitioners should consider implementing targeted anaerobic interventions (e.g., high-intensity interval training) upon resuming training to efficiently restore match-relevant repeated sprint performance without compromising technical or tactical work.

Keywords: short-term detraining, physical performance, in-season break, football

Conflicts of interest: No conflicts of interest declared by the authors.

ASSOCIATIONS BETWEEN INTER-LIMB ASYMMETRIES AND PHYSICAL PERFORMANCE IN UNDER-19 FEMALE FOOTBALL PLAYERS

Nuno Rego^{1*}, Miguel Camões^{1,2}, Eduardo Teixeira^{1,2,3,4,5}

¹School of Sport and Leisure (ESDL-IPVC), Polytechnic Institute of Viana do Castelo, Viana do Castelo, Portugal; ²SPRINT Sport Physical Activity and Health Research & Innovation Center | Centro de Investigação & Inovação em Desporto Atividade Física e Saúde | Portugal FCT Fundação para a Ciência e a Tecnologia | Portuguese Foundation for the Science and Technology | UID/06185/2025 [https://doi.org/10.54499/UID/06185/2025]; ³CIDEFES, FDEF, Lusófona University, Porto, Portugal; ⁴CIFI2D, Faculty of Sports, University of Porto, Porto, Portugal; ⁵Interdisciplinary Centre for Education and Development (CeIED), Lusófona University, Lisboa, Portugal

*Corresponding author:
Nuno Rego
+351 916552878
7nunorego@gmail.com

Introduction: Physical performance (PP) in women's football has become a key focus of contemporary research. Among the determinants of PP, inter-limb asymmetries (ILA) in strength and power have gained increasing attention, yet evidence in under-19 (U19) female players remains limited.

Objective: To quantify ILA magnitude in U19 athletes and examine their associations with key PP outcomes, namely sprint, change-of-direction (COD), and jump performance.

Methodology: Nineteen U19 female players (17.0±1.04 years; 59.4±6.97 kg; 1.63±0.05 m) underwent a field-based assessment including unilateral and bilateral horizontal jumps (HJ), 20-m linear sprint, and an agility T-test with COD to both sides. ILA were calculated as percentage differences in lower-limb power (m) derived from unilateral HJ. PP measures comprised bilateral HJ distance, 20-m sprint time, and T-test time. Descriptive statistics and Pearson's correlation coefficients (r, 95% CI) were used to analyze associations between ILA and PP.

Results and discussion: ILA ranged from 0–18%, with a median of 3.59%, indicating low-to-moderate but heterogeneous asymmetry profiles. ILA displayed a weak, non-significant correlation with sprint performance (r = 0.20, 95% CI -0.27 to 0.60, p > 0.05) but a moderate, significant correlation with COD performance (r = 0.56, 95% CI 0.14 to 0.80, p = 0.013). Overall, ILA in this cohort appears limited in magnitude yet sufficiently large to impact COD more than linear sprint performance, aligning with previous work in female footballers. From an applied perspective, these findings support integrating ILA monitoring into routine PP testing to detect functionally relevant imbalances.

Conclusion: In these U19 athletes, small-to-moderate ILA in lower-limb power is common and is more strongly associated with COD than with sprint performance. Larger, longitudinal studies are needed to confirm causal pathways and to establish meaningful cut-offs to guide targeted interventions.

Keywords: Soccer, Imbalances, Fitness levels, Muscle Strength, Muscle Power

Conflicts of interest: No conflicts of interest declared by the authors.

UEFA WOMEN'S EURO 2025: IDENTIFYING TACTICAL FINGERPRINTS THROUGH CLUSTER ANALYSIS OF PASSES INTO THE FINAL THIRD

Rafael Lopes^{1,2,3*}, Marta Galvão¹, João Brito¹, Bruno Travassos^{1,2,3}

¹University of Beira Interior, Sports Sciences Department, UBI, Covilhã, Portugal; ²Research Center in Sports Sciences, Health Sciences and Human Development, CIDESD, Vila Real, Portugal; ³FPF Academy, Portuguese Football Federation, FPF, Lisbon, Portugal

*Corresponding author:
Rafael Lopes
+351 965542799
rafael.lopes@ubi.pt

As performance analysis shifts from aggregated statistics to spatial-temporal dynamics, identifying tactical patterns has become essential for scouting and opposition analysis. This study investigated whether teams competing in the UEFA Women's Euro 2025 displayed distinct and quantifiable differences in their passing behaviour into the final third of the pitch.

A two-stage analytical approach was applied using passing events from the competition database. Data preparation and cleaning were conducted in Python using Jupyter Notebook. In the first stage, a tactical "fingerprint" for each team was established through K-Means clustering (k = 5) based on three spatial metrics: width (average distance of passes endpoints from the pitch centre), verticality (net forward distance gained by a pass, X_end - X_start), and penetration (frequency of final-third passes ending in the final 1/6 of the pitch). Five clusters emerged: hybrid/central, hybrid/wide, box-attack/wide, possession/wide, and direct/central (silhouette score = 0.45). The second stage segmented final-third entries into successful and unsuccessful outcomes. Gaussian kernel density estimation was used to generate origin heatmaps, and a secondary K-Means clustering layer identified dominant entry vectors for each team. This dual-layered framework reveals clear profiles between teams. Spain and France showed a possession/wide approach, characterized by shorter passes and wide-space exploitation. Iceland and Poland aligned with the direct/central profile, using longer, more vertical passes to reach the opposition goal. The Netherlands and Belgium fell into the box-attack/wide profile, frequently delivering long balls towards the end zone of the pitch. Portugal and Italy exhibited a hybrid/central pattern, combining short and long passes through central channels. England and Sweden also displayed hybrid behaviour but favoured wide zones.

Overall, this study showed that team profiles can be mathematically segmented from performance outcomes. The integration of clustering and spatial density mapping offers coaches and analysts an objective tool for team and opposition analysis.

Keywords: key performance indicators, performance analysis, women's football

Conflicts of interest: No conflicts of interest declared by the authors.

ANALYSIS OF THE OFFENSIVE PROCESS OF SUCCESSFUL TEAMS IN THE 2022 FIFA WORLD CUP

André Barreto^{1*}, Alberto Cortez^{2,3}, Hugo Folgado, Pedro Fatela⁴

¹Faculdade de Motricidade Humana, Universidade de Lisboa, Portugal; ²Universidade de Évora, Comprehensive Health Research Centre (CHRC), Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde; ³Universidade de Évora, Comprehensive Health Research Centre (CHRC), Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde; ⁴CIPER, Faculdade de Motricidade Humana, Universidade de Lisboa, Portugal

*Corresponding author:

André Barreto
+351 962410836
andresilveirobarreto@gmail.com

The study analyzed the offensive process of the finalists (i.e., Argentina and France) in the 2022 World Cup, based on passing actions between players, with a particular focus on distance to reception as an indicator of the receiver's movement between the moment of the pass and the reception.

The sample included 6,199 records of effective passes made during fourteen games, seven per team, including the first and second phase games of the competition. The intention was to analyze the impact of structural variables (i.e., team), contextual variables (i.e., phase of the competition; state of play), spatial (i.e., reception zone), and technical-tactical variables (i.e., distance and direction of the pass; type of run) on the distance of pass reception, first in isolation and then through interaction with the team variable, seeking to determine whether the patterns of the offensive process and the strategic dynamics of successful teams remain consistent within the competitive context in which they operate. The hierarchical structure of the data and the continuous, positive, and asymmetric nature of the dependent variable justified the application of the Generalized Linear Mixed Model (GLMM), with Gamma distribution and log link function. The results showed statistical significance between the receiving distance and a set of defined fixed effects (i.e., stage of the competition; pass distance; type of run; receiving zone; team), except for the match result. In the comparative analysis of the interactions between the team, reception distance, and defined fixed effects, the only significant interaction at the global level of the model occurred in the game result. However, specific variations were identified in different factors of the fixed effects, with Argentina showing significant differences in receiving distance compared to France at the following levels: backward passes; direct and supporting runs; offensive sector.

The results suggest that, at the level of elite national teams, there may be a similar pattern of behavior at the macro level with regard to offensive principles, while differences in their behavior are observed at the micro level—such as specific adaptations to unexpected changes in context or even strategic nuances in certain approaches to anticipated constraints.

Keywords: Game analysis, Successful teams, Offensive process, Pass, Receiving distance, Offensive mobility

Conflicts of interest: No conflicts of interest declared by the authors.

THE IMPACT OF PLAYING THREE MATCHES A WEEK IN HOT ENVIRONMENTS ON PERFORMANCE FOR DIFFERENT POSITIONS

Mikinobu Yasumatsu^{1,2,3*}, Daisuke Nakamura^{2,3}, Yoko Tanabe^{3,4}, Kaito Iwayama^{3,5}, Aya Ishibashi^{3,6}, Mariko Nakamura³, Yasumitsu Ishii^{3,7}, Hideyuki Takahashi^{3,4}

¹College of Sport and Wellness, Rikkyo University, Saitama, Japan; ²Japan Football Association, Tokyo, Japan; ³Japan Institute of Sports Sciences, Tokyo, Japan; ⁴Tsukuba University, Ibaraki, Japan; ⁵Tenri University, Nara, Japan; ⁶Toyo University, Saitama, Japan; ⁷Kyoto University of Advanced Science, Kyoto, Japan

*Corresponding author:

Mikinobu Yasumatsu
+81-90-8647-8656
yasumatu@rikkyo.ac.jp

Football players are supposed to play 3 matches in 7 days in the Summer Olympic Games, which means having only 3 days (72 hours) of recovery between the matches. Moreover, it is well known that exercise performance is limited in hot environments, such as those commonly experienced during the Summer Olympics. The present study was conducted to examine the impact of playing three matches a week in hot environments on performance for different positions.

Twenty-nine male collegiate soccer players competed in 3 matches (M1, M2 and M3) in 7 days with a 2 days' break each in hot conditions. GPS (15 Hz; GPSport) was utilized to monitor the activity profiles during the matches. The analysis by position categorised players into four positions: centre-backs (CB), central midfielders (CMF), forwards (FW) and full-backs/wing-backs (FB/WB). Differences in the activity profiles between 3 matches were determined using a one-way repeated-measures analysis of variance (ANOVA). In the case of a significant difference between 3 matches, a Tukey's post hoc test was used to identify the points of difference.

The total distance (TD) and the distance covered in high-intensity running (HIR; >13 km/h) were significantly lower in M2 and M3 compared to M1 ($p < 0.05$) in all positions. In CB, CMF and FB/WB, there were no differences in TD and HIR between all the 3 matches. However, TD was significantly lower in M2 and M3 compared to M1 ($p < 0.05$), HIR was significantly lower in M3 compared to M1 ($p < 0.05$) in FW. The physical performance during the 3 matches separated only by 3 days each in hot environments decreased towards the third match. It has been suggested that, given the decline in performance among the forwards, the team should consider how to manage the attacking players during the group stage in the Olympic games.

Keywords: Football, physical demands, hot environment, Olympic games

Conflicts of interest: No conflicts of interest declared by the authors.

IMPACT OF THE INTRODUCTION OF VAR ON THE SATISFACTION, PERFORMANCE AND RETENTION OF FOOTBALL REFEREES IN PORTUGAL

Eduardo Ferreira^{1*}, Vítor Sobral¹, Marisa Sousa¹

¹Research Center in Sports Sciences, Health Sciences and Human Development, CIDESD, University of Maia, Portugal

*Corresponding author:

Eduardo Ferreira

+351 934144154

eduardofgf77@gmail.com

Introduction: Football refereeing is a highly demanding activity, characterized by pressure, media scrutiny and emotional strain, which influence referees' job satisfaction, performance and intention to remain in the role. The introduction of the Video Assistant Referee (VAR) in Portugal in 2017 aimed to improve decision accuracy and promote justice. However, its impact on referees' satisfaction, perceived performance and retention remains insufficiently explored, particularly in the Portuguese context.

Objectives: This study therefore aimed to analyse how VAR influences: (i) referees' job satisfaction; (ii) their satisfaction with on-field performance; and (iii) their intention to remain in refereeing in Portugal.

Methodology: A qualitative, interpretivist approach was adopted to capture referees' subjective experiences with VAR. Data were collected through semi-structured interviews with four Portuguese referees from Liga Portugal, representing different roles and levels of involvement with the system. The data were analysed using thematic analysis, involving coding, theme development and refinement, structured around three key dimensions: transition to VAR, differentiation of roles and retention.

Results: The transition to VAR was considered very demanding, particularly for experienced referees accustomed to making decisions independently. Despite initial uncertainty, VAR was generally seen as a factor that increased the accuracy of decisions, boosted confidence and improved post-match composure, positively influencing job satisfaction and perceptions of performance. However, new psychological demands emerged, including constant communication with the VAR team and concerns regarding evaluation. The distinction between on-pitch referees and VAR specialists reduced pressure across the team. Furthermore, VAR created new career opportunities, contributing to retention.

Discussion/Conclusions: VAR has a paradoxical yet positive impact overall: it increases fairness, confidence and satisfaction, whilst introducing new psychological and organisational challenges. It also contributes to retention by offering broader and alternative career paths, highlighting its role as both a technological and a human resources management tool in refereeing.

Keywords: Digital Transformation, Technology, Innovation, VAR, Refereeing

Conflicts of interest: No conflicts of interest declared by the authors.

ASSOCIATIONS BETWEEN VARIATIONS IN NIGHT SLEEP DURATION, SLEEP DEBT AND CHANGES IN PERCEIVED FATIGUE IN MALE YOUNG FOOTBALL PLAYERS

João Barreira^{1*}, João Brito^{2,3}, Fábio Y. Nakamura^{1,4,5}, Pedro Figueiredo^{6,7}

¹Research Center in Sports Sciences, Health Sciences, and Human Development (CIDESD), University of Maia, 4475-690, Maia, Portugal;

²FPF Academy, Portuguese Football Federation, Oeiras, Portugal; ³CIPER, Faculdade de Motricidade Humana, Universidade de Lisboa, Portugal; ⁴Graduate Program in Physical Education, Federal University of Pernambuco, Recife, Brazil; ⁵FSI Lab, Football Science Institute, Granada, Spain; ⁶Physical Education Department, College of Education, United Arab Emirates University, Al Ain, Abu Dhabi, United Arab Emirates; ⁷Research Center in Sports Sciences, Health Sciences, and Human Development (CIDESD), Maia, Portugal

*Corresponding author:

João Barreira

+351 915941924

joao.barreira@fpf.pt

Introduction: Sleep is a key determinant of recovery in athletes, yet its day-to-day relationship with perceived fatigue remains unclear.

Objectives: This study aimed to examine the sleep patterns, perceived fatigue, and within-athlete associations between sleep measures and changes in perceived fatigue in young male football players.

Methodology: Daily sleep and perceived fatigue data were collected over five consecutive weeks in 47 young male football players from a Portuguese academy (804 observations). Sleep duration (standardized relative to each athlete's mean) and sleep deficit (self-reported sleep need minus sleep duration) were derived from actigraphy. Perceived fatigue was assessed using the Rating-of-Fatigue scale. Δ -fatigue was calculated as the change between night-time and next-morning fatigue. Linear mixed-effects models and ordinal linear-mixed models were used to examine associations between sleep variables, next-morning fatigue (ordinal), and Δ -fatigue.

Results: Greater sleep deficit was associated with higher odds of reporting greater next-morning fatigue ($\beta = 0.36 \pm 0.06$, $p < 0.001$; OR = 1.43). In contrast, longer sleep duration was associated with lower odds of higher fatigue in the following morning ($\beta = -0.32 \pm 0.07$, $p < 0.001$; OR = 0.73). For Δ -fatigue, sleep duration was significantly associated with reductions in next-day fatigue ($\beta = -0.22 \pm 0.04$, $p < 0.001$), whereas sleep deficit showed no association ($\beta = 0.02 \pm 0.03$, $p = 0.54$).

Discussion and Conclusions: Sleep deficit and sleep duration showed different relationships with perceived fatigue. Both were associated with next-morning fatigue perception, but only fluctuations in sleep duration were associated with Δ -fatigue. These findings highlight the importance of sufficient sleep duration for dynamic recovery processes in youth players.

Keywords: adolescents, fatigue, well-being

Conflicts of interest: No conflicts of interest declared by the authors.

ANALYSIS OF TACTICAL AND NETWORK VARIABILITY IN TEAM BEHAVIOUR THROUGH MATHEMATICAL MODELS AND SOCIAL NETWORK ANALYSIS: A CASE STUDY OF PORTUGAL U-17 AT THE 2025 WORLD CUP

José Gama^{1,3,5*}, Gonçalo Dias^{2,3,4,5,6}, Rui Mendes^{2,3,4,5,6}, Vasco Vaz^{1,3}

¹Research Center in Spo

¹University of Coimbra, Faculty of Sports Sciences and Physical Education, 3040-248 Coimbra, Portugal; ²Polytechnic Institute of Coimbra, Coimbra Education School, Rua Dom João III – Solum, 3030-329 Coimbra, Portugal; ³CIPER, Faculty of Human Kinetics, University of Lisbon, Cruz Quebrada-Dafundo, Portugal (UID/06349/2025); ⁴SPRINT – Sport Physical Activity and Health Research & Innovation Center (UID/6185/2023); ⁵Laboratório RoboCorp, IIA, Instituto Politécnico de Coimbra, 3040-256 Coimbra, Portugal; ⁶ESEC-UNICID-ASSERT – Applied Sport Sciences Research Unit (UNICID-ASSERT), Coimbra Education School, Instituto Politécnico de Coimbra, 3040-256 Coimbra, Portugal

*Corresponding author:

José Gama
+351 967336971
josemiguelgama@hotmail.com

Introduction: Mathematical models integrated with Social Network Analysis (SNA) enable the quantification of relational patterns among players in football, providing objective insights into both individual and collective dynamics.

Objectives: The aim of this study was to examine the variability in collective tactical behaviour and network structure of the Portugal U-17 national team across eight matches in the 2025 World Cup, identifying phase-specific tactical adjustments (group stage vs. knockout) and examining their association with individual player contributions.

Methodology: Match data were collected via Wyscout® and analysed using uPATO® software. Macro-metrics (network density, average distance, heterogeneity, and transition entropy) and micro-metrics (degree centrality per player and per positional sector) were calculated to capture team-level and individual-level patterns.

Results and Discussion: At the macro level, the network structure adapted notably from group stages to knockout matches, with lower density, longer average passing distances, and increased heterogeneity, reflecting greater reliance on key players under competitive pressure. Transition entropy remained stable, indicating preservation of team identity. At the micro level, certain players assumed pivotal roles in maintaining cohesion and driving offensive transitions, highlighting individual contributions to collective adaptability.

Conclusions: Portugal U-17 demonstrated a unique ability to adapt collective structures to competitive demands without compromising team identity. Profiling players as core, emergent, or situational provides actionable guidance for post-match analysis and training, supporting coaches in planning tactical adjustments and optimising team performance in future matches.

Keywords: Football, Social Network Analysis, Mathematical Models, Tactical Adaptation, Team Identity

Conflicts of interest: No conflicts of interest declared by the authors.

AN EXPLORATORY ANALYSIS OF CONTEXTUAL FACTORS IN MOST INTENSE PERIODS IN ELITE FOOTBALL

Sofia Ferreira^{1*}, Farzad Yousefian², João Brito³, Duarte Araújo¹

¹CIPER, Human Kinetics Faculty, University of Lisbon; ²Research Centre in Sports Sciences, Health Sciences and Human Development (CIDESD), Department of Sport Sciences, University of Beira Interior, Covilhã, Portugal; ³FPP Academy, Portuguese Football Federation, Oeiras, Portugal

*Corresponding author:

Sofia Ferreira
+351 963154058
a.sofiagfe@gmail.com

Most intense periods (MIP) represent the peak physical demands experienced by players during match-play, commonly defined as the greatest distance covered above a given speed threshold within a specific time window. While these periods are critical from a physiological perspective, they may also reflect key tactical moments. However, current research has largely overlooked the contextual nature of MIP. This exploratory study aimed to contextualize MIP in elite football by identifying tactical conditions under which these high-intensity periods occur. Optical tracking and event data from a single match of the Portuguese National Team during the UEFA Nations League 2025 were analyzed, including 15 players from one team.

MIP was identified for each player using a 1minute rolling window, based on the total distance covered above 15 km·h⁻¹, with the highest value retained per player. Player displacement was computed from positional data using frame-by-frame Euclidean distance and velocity. Each MIP was then characterized according to match timing, ball possession, scoreline, and player position.

Results showed that MIP distance averaged 149.14 ± 31.66 m across players. Higher average values were observed during ball possession (168.47 ± 24.78 m) compared to out of possession (139.83 ± 31.23 m), although maximum values occurred in both contexts. Midfielders presented the highest average MIP values (179.83 ± 13.82 m), followed by forwards (158.65 ± 30.97 m) and defenders (133.07 ± 12.55 m). Additionally, higher average values were observed when the team was winning (157.01 ± 39.68 m) compared to drawing (140.15 ± 18.02 m). MIP events were predominantly observed in the second half of the match.

Despite being limited to a single match, these findings provide preliminary insights into the contextual nature of peak physical demands in football, highlighting the importance of integrating physical and situational variables when analyzing match performance. Such findings may enhance the representativeness of training design and improve the understanding of peak match demands.

Keywords: Most intense periods, match analysis, performance analysis, elite football

Conflicts of interest: No conflicts of interest declared by the authors.

UNFOLDING COLLECTIVE BEHAVIOUR PATTERNS IN ELITE FOOTBALL THROUGH MULTIPLE FACTOR ANALYSIS AND HIERARCHICAL CLUSTERING ON PRINCIPAL COMPONENTS: A MIXED-DATA FRAMEWORK FOR PERFORMANCE ANALYSIS

Luís Caldeira^{1*}, Rui J Lopes^{2,3}, João Ramos¹

¹CIDEFES, Lusófona University, Lisbon, Portugal; ²Iscte, Lisbon, Portugal; ³Instituto de Telecomunicações, Lisbon, Portugal

*Corresponding author:

Luís Caldeira
+351 964487533
luis.caldeira@ulusofona.pt

Introduction: Performance analysis in football increasingly relies on large, complex datasets combining qualitative and quantitative variables, but conventional univariate or purely descriptive approaches struggle to capture the intertwined, context-dependent nature of collective behaviours and their outcomes. Multivariate frameworks capable of handling mixed-type data are essential to advance the field.

Objectives: This work explores the applicability of the Multiple Factor Analysis and Hierarchical Clustering on Principal Components (MFA/HCPC) framework to derive tactical typologies from large mixed-type datasets. The goal is to identify patterns of collective behavior, allowing a meaningful comparison across sexes and competition contexts.

Methodology: Our framework uses Multiple Factor Analysis (MFA) to integrate thematically grouped quantitative and categorical variables without prior transformation. MFA balances heterogeneous blocks through differential weighting, and projects all observations into a common low dimensional space. Hierarchical Clustering on Principal Components (HCPC) is then applied to MFA component scores, using MFA as a denoising step so that clusters reflect stable behavioural configurations rather than stochastic noise, and providing intuitive, interpretable tactical typologies for practitioners.

Results and Discussion: Across different subsamples, MFA reduces complex phenomena into representative dimensions interpretable in terms of core tactical trade-offs (for example, execution profiles). Subsequent HCPC identifies clusters that align with intuitive strategic options, which can be directly translated into coach-friendly narratives and key performance indicators. In our ongoing work, this approach is already producing coherent typologies of collective behaviours and highlighting where male and female teams share, or diverge in, their preferred strategic solutions. Thus facilitating the qualitative interpretation of data.

Conclusions: MFA/HCPC proves to be a valuable, scalable and practitioner-oriented framework for football performance analysis, organizing and interrelating heterogeneous, complex, mixed football data in a meaningful way. It supports evidence-based dialogue with coaches by turning high-dimensional datasets into a small set of interpretable tactical “families”, bridging multivariate statistics and applied game understanding.

Keywords: Performance analysis, Mixed Methods, Multiple Factor Analysis (MFA), Hierarchical Clustering on Principal Components (HCPC)

Conflicts of interest: No conflicts of interest declared by the authors.

TRAINING-METHOD PROFILES AND MOTOR COMPETENCE IN UNDER-13 FOOTBALL PLAYERS: A LONGITUDINAL COMPARATIVE STUDY ACROSS TEAMS

Vítor Padinha^{1,2,3*}, Hugo Folgado^{1,3}, Nuno Batalha^{1,5}

¹Comprehensive Health Research Centre (CHRC), School of Health and Human Development, University of Évora, Portugal; ²Santarém Polytechnic University, Sport Science School of Rio Maior, Portugal; ³Universidade de Évora, Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde, Évora, Portugal

*Corresponding author:

Vítor Padinha
+351 916569445
vitorpadinha@esdrm.ipsantarem.pt

Introduction: Motor competence (MC) is an important component of youth football development, but little is known about whether different training-method profiles are associated with domain-specific changes over time in training contexts.

Objectives: To compare pre-post changes in Motor Competence Assessment total and in the locomotor, stability, and manipulative domains among three under-13 football teams with different training-method profiles. A secondary objective was to examine whether percentage of playing time additionally explained outcomes.

Methods: This longitudinal observational comparative study included 23 players from three teams competing in the same district championship (Team A, n=9; Team B, n=7; Team C, n=7). MC was assessed before and after the observation period using the Motor Competence Assessment, and percentile scores were calculated for the total and each domain. Baseline decimal age, body mass index, and years of federated football practice were recorded. Training sessions were observed for 9 weeks, and each exercise was classified according to Castelo's taxonomy as General Preparation Methods, Specific General Preparation Methods, or Specific Preparation Methods. Baseline-adjusted ANCOVA models were performed for each outcome; secondary models additionally included percentage of playing time.

Results and Discussion: No significant between-team differences were found for post-test MCA total, locomotor, or manipulative percentiles (all $p > .05$). A significant team effect was observed for stability ($F(2,16) = 6.847$, $p = .007$, $\eta^2 = .461$), with Team B showing higher scores than Team A ($\Delta = 26.793$, $p = .013$). This pattern remained after adjustment for percentage of playing time ($F(2,15) = 5.906$, $p = .013$), which was not significant ($p = .674$). Sensitivity analyses excluding girls and, separately, goalkeepers yielded the same interpretation.

Conclusions: Different training-method profiles were associated with domain-specific, but not global, changes in MC. The clearest difference was observed in stability, favouring Team B over Team A, independently of playing time.

Keywords: Motor Competence Assessment, youth football, training methods, stability

Conflicts of interest: No conflicts of interest declared by the authors.

GREATER HIP ADDUCTOR STRENGTH GAINS WITH STATIC VS DYNAMIC EXERCISE IN MALE FOOTBALLERS – AN ECOLOGICAL RANDOMIZED CONTROLLED TRIAL

Guy Sauce¹, Leandro Oliveira², Filipe Ponte², Guenadi Gálvez¹, Bernardo Tavares², Carlos Portugal-Nunes², Eduardo Teixeira^{2,3,4,5,6*}

¹Sport Clube de Beira-Mar, Departamento de Otimização de Rendimento; ²CIDEFES, FDEF, Lusófona University, Porto, Portugal; ³CIFI2D, Faculty of Sports, University of Porto, Porto, Portugal; ⁴Interdisciplinary Centre for Education and Development (CeIED), Lusófona University, Lisboa, Portugal; ⁵School of Sport and Leisure (ESDL-IPVC), Polytechnic Institute of Viana do Castelo, Viana do Castelo, Portugal; ⁶SPRINT Sport Physical Activity and Health Research & Innovation Center | UID/06185/2025 [https://doi.org/10.54499/UID/06185/2025]

*Corresponding author:
Eduardo Teixeira
+351 916104279
edsilvateixeira@gmail.com

Introduction: Hip adductor muscle strength is a key modifiable factor for reducing groin injury risk and enhancing physical performance in football. The Copenhagen Adduction Exercise (CAE) is widely implemented in prevention programs due to its high adductor activation. Still, the comparative efficacy of static versus dynamic CAE variations for improving strength remains unclear.

Objectives: To compare the effects of static versus dynamic long-lever CAE on hip adductor maximal isometric strength (MIS) and rating of perceived exertion (RPE) in male footballers.

Methodology: In this ecological randomized controlled trial, athletes were randomly allocated (1:1) to a static or dynamic CAE group. The static (2×30" long-lever isometric holds/leg) and the dynamic protocol (2×30" long-lever repetitions/leg, 1"eccentric/1"concentric tempo) were performed over four weeks, with session RPE recorded after each session. MIS was assessed immediately before and after the intervention using two 6-second maximal adductor squeeze tests, with 2-minute rest intervals between tests. Between-group comparisons were conducted using the Paired samples T-test (for MIS) and the Independent-Samples Mann-Whitney test (for RPE).

Results and Discussion: Forty-two athletes (16.3±1.8 years; 67.7±7.5 kg; 1.76±0.1 m) were evaluated. The static CAE group (n=23) showed significant MIS gains (51.5±8.6kgf vs. 55.3±8.1kgf, p<0.01), whereas the dynamic CAE group (n=19) did not (50.5±6.3kgf vs. 50.9±5.3kgf, p=0.74). Mean RPE was lower in the static compared with the dynamic group (5.8±1.3 vs. 7.0±0.5, p<0.01), suggesting that static loading elicited superior strength adaptations despite lower perceived effort. These findings indicate that static long-lever CAE may provide a more consistent mechanical stimulus, favoring neuromuscular adaptation over a short intervention period.

Conclusion: Static long-lever CAE exercises are a more effective and tolerable strategy for enhancing hip adductor strength in male youth footballers compared to a dynamic approach. Coaches aiming to optimize adductor strength and potentially reduce injury risk should prioritize static CAE in prevention and conditioning programs.

Keywords: soccer, sports performance, muscle, groin

Conflicts of interest: No conflicts of interest declared by the authors.

A RETURN-TO-PLAY FRAMEWORK FOR RECTUS FEMORIS INTRAMUSCULAR DEGLOVING INJURY: A CASE STUDY IN ELITE YOUTH SOCCER PLAYERS

Francisco Felgueiras*, Thiago Carvalho, Pedro Silva

F.C.Porto

*Corresponding author:
Francisco Felgueiras
+351 916684782
fmmfelgueiras@hotmail.com

Introduction: Intramuscular degloving injuries of the rectus femoris are one of the most unusual and serious injuries in sports that are characterized by the inner bipennate muscle tearing away from the outer unipennate component, appearing as a "muscle-within-a-muscle" lesion on imaging. Due to its low incidence, the research in the area is small, and because of that, there is limited evidence regarding optimal rehabilitation strategies and return-to-play outcomes in this kind of injury in athletes.

Objective: The aim is to describe the rehabilitation and return-to-play process in two elite youth soccer players diagnosed with intramuscular degloving injuries in the rectus femoris localized in the dominant left leg.

Methodology: Two 14-year-old players (from a U15 Portuguese soccer club and the Portuguese national team) had their diagnoses confirmed by magnetic resonance imaging, after initial presentation of pain, as these injuries are commonly misidentified as a simple rectus femoris strain or hematoma. The rehabilitation program included progressive development of the neuromuscular capacity, followed by energy system development and progressive exposure to field high-intensity efforts (high-speed running, sprints, acceleration, deceleration, and change of direction), over a 7–8-week period. Plyometrics, proprioception and strength training were integrated throughout the process. The load progression was adjusted according to the phase of RTP and monitored by GPS (Catapult).

Results and Discussion: Both players successfully returned to full competition 16 weeks after injury. Following a 7–8-week structured return-to-play period based on the described progressions, both athletes were considered clinically ready and met the criteria to return to competition.

Conclusion: This case study demonstrates the feasibility of a structured, criteria-based rehabilitation approach for return-to-play, following a rectus femoris intramuscular degloving injuries.

Keywords: Return-to-play, Muscle injury, Rehabilitation, Sports Performance

Conflicts of interest: No conflicts of interest declared by the authors.

GOALKEEPER DEFENSIVE ACTIONS IN ELITE WOMEN'S FOOTBALL: SITUATIONAL CONSTRAINTS AND ACTION SELECTION

Francisco Xara Brasil*, Anna Volossovitch, Rui Freitas

CIPER, Faculdade de Motricidade Humana, SpertLab, Universidade de Lisboa, Lisboa, Portugal

*Corresponding author:
Francisco Xara Brasil
+351 915484164
franciscoxara@gmail.com

Introduction: Goalkeeper (GK) performance emerges from the interaction between task, individual, and environmental constraints. However, systematic evidence on how these constraints influence GK performance in elite women's football remains limited. Understanding context-specific behavior is, therefore, essential for evidence-based GK coaching.

Objectives: This study aimed to: characterize GK defensive actions across different match situations in elite women's football; examine how environmental and task constraints may be associated with GK action selection and outcome; and identify possible factors linked to success and failure within each context.

Methodology: A systematic observational study analyzed 516 defensive actions from 64 matches involving five GKs competing in the Portuguese women's top division. A validated observational tool was used to code situational, action, and outcome variables. Defensive actions were classified into: Goal Defense (n=248), Crosses (n=147), Sweeping (n=88), and 1x1 situations (n=33). Data were analyzed using chi-square test with Cramér's V, Mann-Whitney U test, Spearman correlations, and logistic regression models.

Results and Discussion: When teams were losing, goal rates were higher (22.9% vs 14.4 vs % 8.3%) and ball security decreased ($H(2)=9.790$, $p=0.008$). GKs from stronger teams faced fewer defensive actions per game ($\rho=0.702$, $p<0.001$). Match situation strongly associated with GK action selection ($V=0.722$, $p<0.001$). In Goal Defense, close central shooting zones were the strongest goal predictor ($OR=7.097$, $p<0.001$), and first-touch shots increased action intensity ($\rho=-0.236$, $p<0.001$). In Cross situations, more players between the ball and the GK was linked with poorer defensive outcomes; set-piece deliveries resulted in punching in 56% of actions compared with 18% in open play. Punching was associated with a higher failure rate than catching, and ($\rho=0.440$, $p<0.001$).

Conclusions: GK actions appear strongly constrained by match context. Shooting location, set-piece conditions, and match status emerged as key performance modulators, informing the design of representative training tasks for elite women's football.

Keywords: Goalkeeper Performance, Women's Football, Defensive Actions, Observational Analysis, Situational Variables, Constraints-based approach

Conflicts of interest: No conflicts of interest declared by the authors.

WHERE SHOULD HE STAND? INVERSE MODELING OF PLAYER POSITIONING IN SOCCER

Omar Refaat¹, Mahmoud Nasr¹, Tamer Basha^{1*}

Cairo University

*Corresponding author:
Tamer Basha
+20 100-336-3916
tamer.basha@eng1.cu.edu.eg

Introduction: Pitch control (PC) models are widely used in soccer analytics to quantify spatial dominance and assess team performance by mapping player positions to control probabilities. However, most approaches are purely forward, overlooking the inverse problem of inferring player positions from desired tactical outcomes, which limits their use in actionable coaching and tactical design.

Objectives: To propose an AI-driven framework that inverts the PC problem by estimating the position of a single player given a target PC map and the positions of all other players. This allows the generation of synthetic dominance maps and subsequently estimate where the player should be positioned to achieve this dominance. This would guide players toward positioning strategies that achieve desired spatial control, offering a tool for tactical analysis, decision support, and training optimization.

Methodology: A CNN-based AI model was developed and trained, validated, and tested on 10,000 randomly selected events from the publicly available World Cup 2022 dataset. For each event, the PC map was computed using standard Spearman-based calculations. The model inputs consisted of the 2D PC map together with the positions of the 21 players, with one player's position masked. To prevent data leakage during evaluation, the masking was applied once per map. The model was then trained to predict the location of the masked player from the remaining inputs.

Results and Discussion: The mean absolute error of the estimate masked player position was 5.4 ± 3.5 m, with an average of 2.8 ± 1.6 m for defenders, and 7.2 ± 2.9 m for attackers.

Conclusion: Our results show that the proposed CNN-based model can reliably infer a player's position from PC and surrounding context, capturing key tactical patterns. By enabling inversion of PC, the model supports the generation of target dominance maps to guide optimal positioning, offering a compact and practical tool for tactical analysis, synthesis, and data-driven coaching.

Keywords: Pitch control, synthetic dominance maps, counterfactual analysis

Conflicts of interest: No conflicts of interest declared by the authors.

NEUROCOGNITIVE ANALYSIS AND INTER-RATER RELIABILITY OF A SYSTEMATIC VIDEO ANALYSIS OF ACL INJURIES IN ELITE MEN'S FOOTBALL

Maria Miguel Castela^{1,2*}, Sara Oliveira^{1,2}, Kostas Spyrou³, António Prieto Veloso¹, João Brito^{1,2}

¹CIPER, Faculdade de Motricidade Humana, Universidade de Lisboa, Portugal; ²FPF Academy, Portuguese Football Federation, Oeiras, Portugal; ³UCAM Research Center for High Performance Sport, Catholic University of Murcia, Murcia, Spain

*Corresponding author:

Maria Miguel Castela

+351963757126

mariamiguelcastella@gmail.com

Introduction: Video analysis is an essential for understanding anterior cruciate ligament (ACL) injury mechanisms in football. Neurocognitive analysis is important for the assessment of inhibitory control, as both motor-response inhibition- failing to halt incorrect actions- and attentional inhibition, resulting in a shift of focus to irrelevant stimuli, frequently contribute to non-contact and indirect contact injuries.

Objective: This study aimed to explore neurocognitive control in professional football players with non-contact or indirect contact ACL injuries, while also assessing the inter-rater reliability of these evaluations.

Methodology: All 88 non-contact or indirect contact ACL injuries identified in male professional football players from the top six European leagues between August 1, 2020, and April 30, 2024, were analysed. Neurocognitive control was evaluated through two key inhibitory functions: attentional and motor response inhibition. Attentional inhibition was operationalized as an error when a player diverted their focus away from the task being performed, towards irrelevant stimuli, such as the ball or the environment, resulting in spatial unawareness; motor response inhibition was assessed by identifying failures to suppress incorrect motor actions, specifically when a player approached an opponent at high speed or failed to react to a deceiving action within a 450-1200 millisecond window. Two independent reviewers evaluated the video footage and inter-rater reliability was quantified using Cohen's kappa (κ) coefficient.

Results and Discussion: Attentional inhibition errors were identified in 24 cases (27%); motor response inhibition errors occurred in 27 cases (31%). The inter-rater reliability for these assessments demonstrated substantial agreement, with Cohen's kappa values of 0.668 and 0.709, respectively. These findings are consistent with previous research, indicating that neurocognitive lapses are significant contributors to non-contact and indirect contact injury mechanisms.

Conclusion: Neurocognitive errors in inhibitory control are prevalent in professional football ACL injuries, and their occurrence can be reliably identified through systematic video analysis.

Keywords: Video analysis, Attentional inhibition, Motor response, Inter-rater reliability, ACL injuries, Elite Football

Conflicts of interest: The authors declare a potential conflict of interest as this research is part of a doctoral program hosted and supported by the FPF Academy, the organizing body of this congress. However, the FPF Academy did not influence the scientific execution or the conclusions of this study.

EFFECTS OF ELASTIC THERAPEUTIC TAPING ON QUADRICEPS STRENGTH AND FATIGUE FOLLOWING AN ISOKINETIC FATIGUE PROTOCOL: A PILOT STUDY

Carriço, R.^{1*}, Bartolomeu, R. F.^{2,3,4,5}, Marreiro, A.², Andrade, S.², Esteves, P.^{2,3}, Teixeira, J. E.^{3,5,6}, Ferreira, R.M.^{7,8,9}, Gonçalves, R.S.^{10,11}

¹Coimbra Health School, Polytechnic University of Coimbra, 3046-854 Coimbra, Portugal, Master's degree in Physiotherapy with a specialization in Clinical Assessment and Application of Movement; ²Polytechnic of Guarda, Guarda, Portugal; ³Sport physical activity and health research & innovation center (SPRINT), Rio Maior, Portugal; ⁴Instituto Politécnico de Bragança, Bragança Portugal; ⁵Research Center for Active Living and Wellbeing (LIVEWELL), Bragança, Portugal; ⁶Polytechnic Institute of Cávado and Ave, Guimarães, Portugal; ⁷Social Sciences, Education and Sport Department, Polytechnic Institute of Maia, N2i, 4475-690 Maia, Portugal; ⁸Scientific-Pedagogical Unit of Physiotherapy, Coimbra Health School, Polytechnic University of Coimbra, 3046-854 Coimbra, Portugal; ⁹Sport Physical Activity and Health Research & Innovation Center (SPRINT), Portugal; ¹⁰Coimbra Health School, Polytechnic University of Coimbra, Rua 5 de Outubro, 3045-043 Coimbra, Portugal; ¹¹Health & Technology Research Center (H&TRC), Coimbra Health School, Polytechnic University of Coimbra, Rua 5 de Outubro, 3045-043 Coimbra, Portugal

*Corresponding author:

Carriço, R.

+351 969137965

rcarricofisio@hotmail.com

Muscle fatigue plays an important role in sports performance, influencing both force production and recovery capacity. Elastic adhesive tapes have been used with the aim of enhancing muscular performance, through mechanisms such as increased blood flow and lymphatic drainage.

The aim of this pilot study was to evaluate the perceived effect of Dynamic Tape[®], Magnetic Tape[®], and Kinesio Tape[®] on quadriceps muscle force production in apparently healthy athletes, during a fatigue-inducing protocol.

Five amateur federated football athletes, healthy and without a history of lower limb injuries, participated in this study. Each participant underwent three intervention sessions (Dynamic Tape[®], Magnetic Tape[®], and Kinesio Tape[®]) over a period of three weeks. In each session, the type of intervention was applied according to the authors' specific instructions, or as described in the literature, covering the quadriceps muscle group from its origin to its insertion. A standardized warm-up process was carried out and a knee extension protocol comprising 40 repetitions at 120° per second was applied using an isokinetic dynamometer, with peak torque values recorded, perceived pain and fatigue index calculated.

The results showed no statistically significant differences ($p > 0.05$) between interventions despite a partial eta squared of aprox. 0.3 in both peak torque and fatigue index. Notwithstanding the nonsignificant differences so far, there is a trend to dynamic tape and kinesio tape to outperform the magnetic tape, with the latter showing the lowest values in all participants. Nevertheless, due to the sample size, further studies with larger samples are required to strengthen these findings.

Keywords: Elastic therapeutic taping, Amateur football players, Peak Torque, Muscle Fatigue

Conflicts of interest: No conflicts of interest declared by the authors.

EXAMINING THE RELATIVE AGE EFFECT IN PORTUGUESE YOUTH FUTSAL: A MULTI-SEASON AND MULTI-LEVEL ANALYSIS OF DISTRICT REPRESENTATIVE TEAMS

Angélia Silva¹, Ricardo Lima^{1,2}, Miguel Camões^{1,2}, Bruno Silva^{1,2*}

¹Escola Superior de Desporto e Lazer, Instituto Politécnico de Viana do Castelo; ²SPRINT Sport Physical Activity and Health Research & Innovation Center | Centro de Investigação & Inovação em Desporto Atividade Física e Saúde | Portugal FCT Fundação para a Ciência e a Tecnologia | Portuguese Foundation for the Science and Technology | UID/06185/2025 [https://doi.org/10.54499/UID/06185/2025]

*Corresponding author:
Bruno Silva
+351 961895665
silvabruno@esdl.ipv.pt

Introduction: In Portugal, futsal has experienced substantial growth, becoming increasingly relevant in the national sports landscape. Selection criteria for young talents are crucial to ensure athletes' long-term development. Despite advances in scientific knowledge, some conservative strategies persist, potentially contributing to the Relative Age Effect (RAE).

Objectives: This study examined the presence and temporal stability of RAE among athletes selected for Portuguese district futsal teams between the 2022/23 and 2024/25 seasons, considering sex, age category, and district association.

Methodology: A total of 2,304 athletes participated (1,583 males, U-13, U-15; 720 females, U-17). Birthdates were grouped into quartiles (Q1–Q4) and analysed using descriptive statistics, chi-square tests, and binary logistic regression modelling the likelihood of being born in Q1 across seasons, to assess selection biases and temporal trends.

Results: A significant association was found between birth quartile and sex ($p < 0.001$). In males, Q1 athletes were overrepresented (30.8%) relative to Q4 (17.4%), consistent across age categories. Logistic regression showed no significant temporal trend ($B=0.065$, $p=0.327$), suggesting a stable but non-progressive effect. In females, quartile distribution was more variable (Q1=22.9%, Q2=22.1%, Q3=30.7%, Q4=24.3%) with no traditional RAE pattern and no temporal trend ($B=0.106$, $p=0.329$). Regional analysis revealed heterogeneity among district associations. For example, Lisboa, Braga, and Coimbra exhibited strong Q1 overrepresentation in males, whereas Viana do Castelo showed an increasing proportion of later-born athletes.

Conclusions: In males, Q1 athletes were overrepresented. Although a consistent selection bias persists in this group with no progressive increase in RAE over time. In females, no RAE pattern was detected. However, and despite overall relative equity, variability across district associations suggests that contextual and organisational factors may influence selection. Nevertheless, the underrepresentation of later-born male athletes highlights the need for evidence-informed selection strategies that prioritise long-term athlete development rather than short-term performance advantages linked to biological maturation.

Keywords: Relative Age Effect, Futsal, Youth Selection, Athlete Development

Conflicts of interest: No conflicts of interest declared by the authors.

REVERSING THE GAME: INVERTIBLE PITCH CONTROL FOR TACTICAL INFERENCE AND DESIGN

Zeyad Abdelfattah¹, Mazen Elzeiny¹, Malak Ibrahim¹, Tamer Basha^{1*}

¹Cairo University

*Corresponding author:
Tamer Basha
+20 100-336-3916
tamer.basha@eng1.cu.edu.eg

Introduction: Pitch control (PC) models are widely used in soccer analytics to quantify spatial dominance from player positions, but current approaches are unidirectional, mapping player configurations to control surfaces. Reversing this mapping is particularly important, as it would enable inference of plausible player configurations from observed control maps, supporting tactical synthesis and decision-making. However, this inversion is challenging due to Euclidean distance-based influence functions, which aggregate effects in a many-to-one, non-invertible manner, limiting inversion methods to descriptive analysis.

Objectives: To propose an invertible PC framework enabling bidirectional mapping between player states and spatial control fields, supporting both forward estimation and inverse inference.

Methodology: We reformulate PC computation within a structured matrix framework by transforming its nonlinear components. Euclidean distance calculations for time-to-intercept are lifted into a higher-dimensional space, enabling matrix-based representation and linearizing quadratic terms. Exponential influence functions are approximated using Hermite quadrature, yielding a matrix-form expression as weighted basis expansions. Together, this allows the PC pipeline to be expressed as matrix multiplications mapping a flattened field grid to a hyperspace representation of player positions via a mapping matrix. Since the inverse problem is ill-posed, we impose constraints to regularize the inversion, adaptable to scenarios such as high pressing or defensive setups. We evaluate the framework on 350 World Cup 2022 events, comparing with a baseline and measuring player reconstruction error.

Results and Discussion: The mean probability error between PC maps from the standard Spearman method and the proposed approach was 0.05 ± 0.09 . Using the inverse method to estimate player positions and regenerate the maps yielded an average correlation factor of 0.88.

Conclusion: An invertible PC framework enables forward estimation and inverse inference of player positions. Results show its effectiveness for tactical and counterfactual analysis and generative applications, with adaptable constraints supporting flexible, context-aware recovery of plausible configurations.

Keywords: Pitch control, invertible pitch control, lifting trick, players positions

Conflicts of interest: No conflicts of interest declared by the authors.

RELATIONSHIP BETWEEN EXTRACURRICULAR SPORTS PARTICIPATION ON EXECUTIVE FUNCTION IN PRESCHOOL CHILDREN: PRELIMINARY FINDINGS FROM THE SUPERQUINAS INTERVENTION

Maurício Fernandes^{1,2*}, Susana Vale³, Carlos Portugal-Nunes¹, José Pedro Guimarães¹, Júlio Costa², André Seabra², Inês-Marques Aleixo¹

¹CIDEFES, Universidade Lusófona; ²ZPF Academy, Portuguese Football Federation, Oeiras, Portugal; ³Gabinete da Secretaria de Estado do Desporto

*Corresponding author:
Maurício Fernandes
+351 919352290
P8881@ulusofona.pt

Introduction: Early childhood is a critical period for the development of cognitive skills, which are essential for learning, behavioral adaptation, and future sport performance. Physical activity has been associated with these outcomes, however, the contribution of extracurricular sports beyond school-based interventions remains insufficiently understood.

Objectives: To examine the association between extracurricular sports participation and practice frequency with executive function in preschool children.

Methodology: Baseline data from 56 children aged 3–6 years enrolled in the SuperQuinas project were analysed. Executive function was assessed using the Head-Toes-Knees-Shoulders task (HTKS; inhibitory control and behavioral regulation) and the Day-Night Stroop task (DNS; cognitive inhibition). Information on extracurricular sports participation (yes/no) and weekly frequency was collected through a structured parent-reported questionnaire. As normality assumptions were violated, results are presented as median and interquartile range (IQR), and group differences were analysed using Mann-Whitney U and Kruskal-Wallis tests.

Results: The sample included 56 children (46,2% females), of whom 40 (71.4%) participated in extracurricular sports and 16 (28.6%) did not. Children engaged in extracurricular sports showed higher HTKS scores compared to non-participants (16 vs 13; $p=0.001$). For DNS, differences were not statistically significant (13 vs 12; $p=0.155$). Regarding practice frequency, no statistically significant differences were found for HTKS ($p=0.396$) or DNS ($p=0.374$).

Conclusions: The engagement in organized sports, regardless of weekly frequency, may play a crucial role in the development of specific executive functions in preschool children. These results reinforce the importance of promoting sports in school-aged children to support both physical and cognitive growth.

Keywords: preschool, extracurricular sport, executive function, inhibitory control

Conflicts of interest: No conflicts of interest declared by the authors.

FROM SPATIOTEMPORAL DATA TO DECISION-MAKING: APPLIED PITCH CONTROL FRAMEWORKS IN ELITE FOOTBALL

José Silva^{1,2*}, Manuel Reis³, Estela Lucas³, Miguel Saraiva¹

¹Scouting and Sports Intelligence, Portuguese Football Federation, Cruz-Quebrada-Dafundo, Portugal; ²Faculty of Human Kinetics, University of Lisbon, Cruz-Quebrada, Portugal; ³Intelligence and Fan Experience, Portuguese Football Federation, Cruz-Quebrada-Dafundo, Portugal

*Corresponding author:
José Silva
+351 919708915
jose.pedro@fpf.pt

Introduction: The growing availability of tracking and event data has transformed performance analysis in football. However, bridging raw positional data and meaningful tactical insights remains a methodological challenge. Pitch Control models offer a dynamic, physics-informed approach to quantify spatial dominance by estimating the probability that a player or team can control the ball at any location on the field. Unlike static spatial models, Pitch Control integrates movement dynamics and temporal constraints to produce actionable spatiotemporal maps.

Objectives: This study presents an integrated video-data workflow built around the Pitch Control framework. The objectives are: (i) to formalize a reproducible computational pipeline from tracking data to probabilistic control surfaces; (ii) to demonstrate applied use cases in tactical analysis and training design; and (iii) to discuss how Pitch Control metrics enhance contextualized video feedback for coaches and players.

Methodology: The model computes spatial control as a function of interception time, and post-arrival control time. Player motion equations incorporate current position, velocity vector, and acceleration, allowing dynamic estimation of time-to-arrival at any pitch coordinate. The resulting probabilities (0–1 scale) generate continuous control maps, where values near 1 indicate team dominance, 0 indicate opponent control, and 0.5 represent contested zones. These outputs are synchronized with broadcast and tactical camera footage through an automated integration pipeline.

Results and Discussion: Applications reveal how Pitch Control clarifies passing risk, pressing efficiency, rest-defense organization, and spatial occupation during transitions. Compared to Voronoi-based models, the dynamic formulation better captures directional momentum and anticipatory advantage. Integrating visual overlays with probabilistic metrics improves interpretability, facilitating evidence-based tactical discussions.

Keywords: Pitch control, tracking data, spatiotemporal analysis, tactical performance analysis

Conflicts of interest: No conflicts of interest declared by the authors.

CONTEXTUAL AND TACTICAL DETERMINANTS OF ATTACKING EFFICIENCY IN ELITE WOMEN'S INTERNATIONAL FUTSAL

Jakob Knauss^{1*}, Daniele Conte^{1,2}

¹Lithuanian Sports University; ²University of Rome "Foro Italico"

*Corresponding author:
Jakob Knauss
+1 608 609 6216
jaknauss13@gmail.com

Introduction: The inaugural FIFA Women's Futsal World Cup provides a unique context to analyze attacking efficiency in elite women's futsal, which depends on tactical structure and match context. Analyses integrating tactical patterns, match state, and scoring outcomes remain limited but are critical for coaching strategies.

Objectives: This study examined how attacking structure and contextual factors influence attacking efficiency, measured as shot outcomes, in elite women's international futsal.

Methodology: Eight knockout-stage matches were analyzed at possession and shot levels. Attacking structures included positional, transitional, set piece, and fly goalkeeper attacks. Contextual factors included time segment (5-minute cuts) and match state (winning, drawing, losing). Shot outcome (goal vs no goal) was the primary metric. Chi-square tests evaluated associations between attacking structure and shot outcome, while Fly GK vs positional comparisons when trailing illustrated risk-reward trade-offs. Descriptive statistics summarized possession duration, number of passes, and scoring efficiency. Fly GK possessions occurred in trailing situations with numerical superiority.

Results and Discussion: Attacking structure was significantly associated with shot outcome ($p = 0.003$). Transitional attacks had the highest scoring efficiency. Positional attacks were relatively effective, similar to Fly GK and better than set pieces. When trailing, Fly GK produced 48 shots and 4 goals but also 6 goals conceded, illustrating the high-risk, high-reward trade-off. Transitional attacks involved shorter possessions, Fly GK possessions were longer, and positional attacks were intermediate in duration and number of passes. Efficiency was higher when possessions started in the attacking half, shots originated inside the goal area, and during the first 10 minutes.

Conclusions: Attacking efficiency in elite women's international futsal depends on tactical structure and match context. Transitional attacks are most efficient, positional attacks are relatively effective, Fly GK offers high-risk scoring opportunities, and set pieces are less efficient. These findings provide practical insights for coaching and tactical decision-making.

Keywords: futsal, attacking structure, shot efficiency, Fly GK, set piece, tactical analysis

Conflicts of interest: No conflicts of interest declared by the authors.

COMPETITIVE WALKING FOOTBALL AS A MARKER OF ACTIVE AGEING: FOOTBALL EXPERIENCE, PARTICIPATION PATTERNS, AND MULTI-SPORT ENGAGEMENT

Catarina Mendes¹, Armando Raimundo^{1,2}, Marco Gonçalves¹, Rodrigo Silva¹, Diego Augusto⁴, Rute Soares⁴, César André Coelho⁴, André Seabra⁴, Júlio A. Costa⁴, Bruno Gonçalves^{1,2,4*}

¹Universidade de Évora, Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde; ²Universidade de Évora, Comprehensive Health Research Centre (CHRC); ³State University of Rio de Janeiro (UERJ), Post-Graduate Program in Exercise and Sport Sciences, Rio de Janeiro – RJ, Brazil, Laboratory of Football Studies (LABESFUT), Rio de Janeiro – RJ, Brazil; ⁴FPF Academy, Portuguese Football Federation, Oeiras, Portugal

*Corresponding author:
Bruno Gonçalves
+351 968175576
bgoncalves@uevora.pt

Introduction: Competitive Walking Football offers older adults a structured way to remain involved in organized football-related participation and may reflect broader patterns of active ageing.

Objectives: To characterize participation patterns in competitive Walking Football and examine associations between football background, length of participation, session structure, and current engagement in other sports.

Methodology: A cross-sectional study was conducted with 83 participants in a Portuguese competitive Walking Football context. Data were collected through a questionnaire covering age, sex, education, previous football experience, football background, years of participation, weekly frequency, session duration, perceived meaning of participation, and current engagement in other sports. Descriptive statistics were computed. Associations between categorical variables were tested using chi-square tests with Cramer's V, and age differences were assessed using the Kruskal-Wallis test.

Results and Discussion: Participants were aged 60.5 ± 6.6 years and were predominantly male (95.2%). Most reported previous football experience (91.6%), with recreational and mixed backgrounds equally represented (38.6% each). Participation was mostly recent, with 38.6% reporting 0–1 years and 25.3% reporting 1–3 years. Most practiced once per week (66.3%), and session duration was usually 45–60 minutes (42.2%) or more than 60 minutes (39.8%). More than half (54.2%) also practiced another sport. No significant associations were found between current engagement in other sports and football background or years of participation. However, years of participation were significantly associated with session duration ($\chi^2=30.2$, $p<.001$, Cramer's $V=0.427$), with more experienced participants reporting longer sessions. Age also differed according to current participation in other sports ($\chi^2=3.91$, $p=.048$).

Conclusions: Competitive Walking Football appears to attract older adults with strong football experience and regular participation habits. Longer experience in the modality is associated with longer sessions, suggesting increasing commitment over time. These findings support competitive Walking Football as a meaningful and structured expression of active ageing.

Keywords: Walking Football, Active ageing, Older adults, Sport participation, Football background

Conflicts of interest: No conflicts of interest declared by the authors.

WALKING FOOTBALL IN ACTIVE AGEING: FOOTBALL BACKGROUND, INTERRUPTION, AND RE-ENTRY INTO SPORT PARTICIPATION IN A COMPETITIVE NATIONAL TOURNAMENT CONTEXT

Marco Gonçalves¹, Armando Raimundo^{1,2}, Raquel Aparicio-Mera³, Rodrigo Silva¹, Diego Augusto⁴, Rute Soares⁵, César André Coelho⁵, André Seabra⁵, Júlio A. Costa⁵, Bruno Gonçalves^{1,2,5*}

¹Universidade de Évora, Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde; ²Universidade de Évora, Comprehensive Health Research Centre (CHRC); ³IGOID Research Group, Faculty of Sport Science, University of Castilla-La Mancha, Toledo, Spain; ⁴State University of Rio de Janeiro (UERJ), Post-Graduate Program in Exercise and Sport Sciences, Rio de Janeiro – RJ, Brazil, Laboratory of Football Studies (LABESFUT), Rio de Janeiro – RJ, Brazil; ⁵FPP Academy, Portuguese Football Federation, Oeiras, Portugal

*Corresponding author:
Bruno Gonçalves
+351 968175576
bgoncalves@uevora.pt

Introduction: Walking Football has recently expanded into competitive formats for older adults motivated by organized play and competition. The first Portuguese Competitive Walking Football Tournament provided an opportunity to explore their sporting trajectories.

Objectives: To characterize participants in the first Portuguese Competitive Walking Football Tournament and examine whether the meaning attributed to participation is associated with previous football experience, interruption of regular sport practice, and current engagement in other sports.

Methodology: A cross-sectional study was conducted with 83 participants from the tournament sample. Data were collected through a questionnaire covering sociodemographic characteristics, previous football experience, football background, years of Walking Football participation, interruption before entry into the sport, current participation in other sports, and the meaning attributed to Walking Football. Descriptive statistics were computed, and associations between categorical variables were examined using chi-square tests. Age differences between groups were assessed using the Kruskal-Wallis test.

Results and Discussion: Participants were aged 60.5±6.6 years and were predominantly male (95.2%). Most respondents reported previous football experience (91.6%), with recreational and mixed football backgrounds being the most frequent (38.6% each). Walking Football was mainly perceived as a continuation of lifelong sport participation (74.7%), whereas 21.7% identified it as a return to sport after interruption. A significant association was found between the meaning attributed to Walking Football and the duration of prior interruption ($\chi^2=30.0$, $p<.001$, Cramer's $V=0.425$). Another significant association was found between the meaning attributed to Walking Football and current participation in another sport ($\chi^2=11.3$, $p=.004$, Cramer's $V=0.369$). No significant differences were found according to previous football participation, football background, or age.

Conclusion: Competitive Walking Football appears to attract mainly adults with a previous football background and to function as a means of sustaining lifelong sport participation, while also providing an opportunity for re-entry into organized sport after prolonged interruption.

Keywords: Walking Football, Active ageing, Older adults, Sport re-entry, Football background

Conflicts of interest: No conflicts of interest declared by the authors.

ANALYSIS OF ATTACKING PERFORMANCE DATA IN THE ENGLISH PREMIER LEAGUE

Islam Mahmoud

Faculty of Sport Sciences, Mansoura University, Egypt

*Corresponding author:
+20 1062452458
mosaad_is@mans.edu.eg

Introduction: The evaluation of attacking performance in football has seen significant development thanks to the use of analytical metrics, such as expected goals (xG), which provide a more accurate representation of chance quality compared to traditional indicators like goals and shots. Understanding how these variables interact is crucial for assessing the effectiveness of teams in elite competitions, such as the English Premier League (EPL).

Objectives: This study aims to analyze the attacking performance of Premier League teams by examining the relationships between goals, expected goals, shots, and passes. It seeks to identify the key factors influencing scoring success, assess finishing efficiency, and characterize the attacking patterns of the teams.

Methodology: A quantitative, descriptive, and comparative research design was employed, utilizing team-level data from 20 Premier League clubs. The variables included goals scored, expected goals (xG), total shots, and passes. Derived metrics, such as finishing efficiency (goals - xG) and shooting efficiency (goals/shots), were calculated. Statistical analyses included descriptive statistics, correlation analysis, and regression modeling (simple linear and logistic regression) to assess the relationships between variables and predict goal-scoring performance.

Results and Discussion: The results revealed a strong positive correlation between expected goals (xG) and goals scored, confirming that expected goals are the most reliable predictor of attacking output. The number of shots also showed a significant correlation with goals, although its effect diminished when adjusted for expected goals. Passes showed a moderate and indirect correlation with goals scored. Regression analysis indicated that expected goals alone explained a large proportion of the variance in goals, while finishing efficiency explained the differences between teams with similar levels of chance creation. The significant variances between goals and expected goals highlighted the role of conversion efficiency and variance in performance outcomes.

Conclusions: Attack success in the Premier League depends on both the quality of opportunities created and the efficiency of converting them. Expected goals emerge as a strong metric for assessing performance, while finishing efficiency explains deviations from expected outcomes. Therefore, a multi-dimensional analytical approach is essential for accurately assessing offensive performance in professional football.

Keywords: Football, Soccer, Performance Analysis, Attacking

Conflicts of interest: No conflicts of interest declared by the authors.

BEHAVIOURAL ADAPTATIONS ACROSS THE COMPETITIVE SEASON IN UNDER-14 FOOTBALL PLAYERS DURING SMALL-SIDED GAMES

Paulo Pereira^{1,2*}, Bruno Gonçalves^{1,2}, Tiago Ludovino¹, Catarina Mendes¹, Mateus Vieira¹, Orlando Fernandes^{1,2}, Hugo Folgado^{1,2}

¹Universidade de Évora, Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde; ²Universidade de Évora, Comprehensive Health Research Centre (CHRC)

*Corresponding author:
Paulo Pereira
+351 962733831
pjpereira93@gmail.com

Introduction: Small-sided games (SSG) are widely used in youth football to develop behaviours in representative performance contexts. Across a season, systematic exposure to training and match-play may induce adaptations in how players interact with teammates, opponents, and goal-related information.

Objectives: To analyse the effect of the competitive season on the behavioural responses of under-14 football players during SSG

Methodology: Twenty-seven under-14 players (two clubs) were assessed at the early and end of the season. At each moment, players performed three 6-minute SSG (GK+4vs4+GK) bouts (twelve total). Data were collected using GPS and video recordings, and integrated to compute the analysed variables. Variables related to offensive context, spatial interaction, and movement behaviour were examined. Linear mixed models tested seasonal effects, with player ID included as a random effect to account for repeated observations.

Results and Discussion: Compared with the early season, players at the end of the season performed actions significantly closer to the goal ($\beta = -8.39$, $p < .001$), with lower shooting angle ($\beta = -12.1$, $p < .001$), and shorter distances from opponents ($\beta = -1.48$, $p < .001$). Movement-related variables include increases in walking ($\beta = 11.9$, $p < .001$) and mean distance to locus ($\beta = 0.84$, $p < .001$), alongside a decrease in low-speed running ($\beta = -16.4$, $p = .032$). In addition, players were closer to their nearest teammate ($\beta = -0.36$, $p = .039$), while the variability of teammate and opponent interpersonal distances increased ($\beta = 6.00$, $p < .001$; $\beta = 5.99$, $p = .004$). No significant differences were found in total distance covered, passing distance, distance to nearest defender, or number of defenders between ball and goal.

Conclusions: The competitive season induces behavioural adaptation in under-14 football players through changes in spatial-temporal interaction and offensive context rather than in overall locomotor volume.

Keywords: Youth soccer, small-sided games, GPS, video analysis, mixed models, spatial-temporal behaviour

Conflicts of interest: No conflicts of interest declared by the authors.

INFLUENCE OF PLAYING EXPERIENCE ON BEHAVIOURAL RESPONSES OF UNDER-14 FOOTBALL PLAYERS DURING SMALL-SIDED GAMES

Rodrigo Silva¹, Hugo Folgado^{1,2}, Orlando Fernandes^{1,2}, Bruno Gonçalves^{1,2}, Pedro Baleizão¹, Rodrigo Tavares¹, Paulo Pereira^{1,2*}

¹Universidade de Évora, Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde; ²Universidade de Évora, Comprehensive Health Research Centre (CHRC)

*Corresponding author:
Paulo Pereira
+351 962733831
pjpereira93@gmail.com

Introduction: Small-sided games (SSG) are commonly used in youth football to examine players' behavioural responses under representative performance conditions. Playing experience may influence how young players interact with teammates, opponents, and task constraints, shaping their tactical and spatial behaviour.

Objectives: To analyse the influence of playing experience on the behavioural responses of under-14 football players during SSG.

Methodology: Thirty-one under-14 football players from two clubs participated in this study. All players performed 6-minute SSG (Gk+4 vs 4+Gk), with repeated observations collected in four moments across the season. Data were obtained through the integration of GPS and video-based notational analysis. Players were grouped according to years of practice using hierarchical cluster analysis (Ward's method), resulting in three experience levels: low (2–4 years), intermediate (5–6 years), and high (7–8 years). Variables related to movement behaviour, offensive context, and spatial interaction were analysed using linear mixed models, with player ID included as a random effect.

Results and Discussion: Experience level showed significant effects in a limited number of variables. Compared with low-experience players, highly experienced players presented greater distance to the nearest defender ($\beta = 1.90$, $p = .011$), greater passing distance ($\beta = 2.03$, $p = .010$), and greater variability in distance to the nearest opponent ($\beta = 7.11$, $p = .012$). No significant differences were found for distance to goal, shooting angle, number of defenders between the ball and the goal, distance to the nearest opponent, total distance covered, velocity-based measures, mean distance to locus, mean distance to centroid, or teammate-related distance measures ($p > .05$).

Conclusions: Playing experience appears to have a selective rather than generalized influence on behavioural responses in under-14 football players during SSG. More experienced players showed differences mainly in interpersonal and passing-related behaviours, suggesting a distinct spatial management of play.

Keywords: Youth soccer, small-sided games, playing experience, mixed models, behavioural analysis

Conflicts of interest: No conflicts of interest declared by the authors.

FOOD INTAKE SEQUENCE AFFECTS FREE-LIVING GLYCAEMIC RESPONSES DURING EXERCISE IN ELITE FEMALE FOOTBALL PLAYERS

Rita Giro^{1,2,*}, Vítor H. Teixeira^{1,3,4}, Nuno Borges^{1,5}, Joana Reis^{2,6,7}, Cláudia Febra², Inês Mendes², Júlio A. Costa², Rodrigo Abreu², João Brito^{2,7}

¹Univers

¹Faculty of Nutrition and Food Sciences, University of Porto, Porto, Portugal; ²FPF Academy, Portuguese Football Federation, FPF, Oeiras; ³Research Centre in Physical Activity, Health and Leisure (CIAFEL), Faculty of Sports, University of Porto, Porto, Portugal; ⁴Laboratory for Integrative and Translational Research in Population Health (ITR), University of Porto, Porto, Portugal; ⁵CINTESIS@RISE, Department of Community Medicine, Information and Health Decision Sciences (MEDCIDS), Faculty of Medicine, University of Porto, Porto, Portugal; ⁶Laboratory of Physiology and Biochemistry of Exercise, Faculty of Human Kinetics, Universidade de Lisboa, Cruz Quebrada - Dafundo, Portugal; ⁷Interdisciplinary Center for the Study of Human Performance (CIPER), Faculty of Human Kinetics, Universidade de Lisboa, Cruz Quebrada - Dafundo, Portugal.

*Corresponding author:

Rita Giro

+351 912748205

up201307940@edu.fcna.up.pt

Food intake sequence can modulate postprandial metabolic, hormonal and appetite responses, but its effects during exercise in free-living athletes remain unexplored. This study investigated how food intake sequence in the pre-exercise meal influenced interstitial glucose (IG) responses during football-specific exercise in elite female athletes.

During a training camp, 20 elite female football players from the Portuguese Under-23 National Team [age: 20.6 (1.2) y, BMI: 22.5 (1.6) kg/m², fasting blood glucose: 5.0 (0.2) mmol/L] standardised their breakfast composition over 5 days. In a randomised, counterbalanced crossover manner, rapidly absorbed carbohydrate (CHO) sources were consumed at the end (CHO-last) or at the start (CHO-first) of the meal on days 2-3, and in the alternative sequence on days 4-5. During 45-min pitch-training sessions 2-2.5 hours post-breakfast on days 2 and 4, IG concentrations were continuously monitored (Freestyle Libre Pro IQ) and GPS metrics collected (10 Hz; STATSports). Measures of glycaemic variability [SD, CV (%), percentage of time <3.9, within 3.9-7.8, and >7.8 mmol/L (%)] were calculated. Within-participant linear mixed models included condition (CHO-first, CHO-last), time (15-min intervals), study day, and their interactions as fixed effects. Results are mean difference [95% CI].

The CHO-last meal pattern exerted lower IG concentrations immediately before exercise (-0.3 [-0.5; -0.02] mmol/L, *p* = 0.037) and lower mean IG during exercise (-0.7 [-1.0; -0.5] mmol/L, *p* < 0.001) than CHO-first. The SD (-0.16 [-0.40; 0.07] mmol/L, *p* = 0.172), CV (-2.1 [-5.3; 1.1]%, *p* = 0.182), time within the normoglycaemic range (5.2 [-4.0; 14.4]%, *p* = 0.254), and GPS metrics (all *p* ≥ 0.05) were comparable between conditions. Study day effects were detected in some GPS variables.

Food intake sequence in the pre-exercise meal may influence glucose concentrations at the onset of and during free-living football-specific exercise in elite female players, though confirmation in tightly controlled settings is warranted.

Conflicts of Interest: Reis, J., Febra, C., Mendes, I., Costa, J., Abreu, R. and Brito, J. work as staff members of National Teams at the Portuguese Football Federation (FPF).

Keywords: food order, glucose metabolism, glycaemic variability, sports nutrition, soccer

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