



Akademia Wychowania Fizycznego
im. Jerzego Kukuczki w Katowicach

Międzynarodowa Konferencja Naukowa

NOWOCZESNE STRATEGIE WSPOMAGANIA ZDROWIA, SPRAWNOŚCI I TRENINGU SPORTOWEGO

15–17 marca 2024 r.

Patronat honorowy
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Prof. dr hab. Grzegorz Juras



KSIĄŻKA ABSTRAKTÓW

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International Scientific Conference

NOVEL STRATEGIES OF ENHANCING HEALTH, FITNESS AND SPORTS PERFORMANCE

15th-17th March 2024

Honorary patronage

His Magnificence Rector of the Academy
of Physical Education in Katowice
Prof. Grzegorz Juras



BOOK OF ABSTRACTS

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Szanowni Państwo,

W dniach 15–17 marca 2024 r. w Akademii Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach odbyła się Międzynarodowa Konferencja Naukowa pt. „Nowoczesne Strategie Wspomagania Zdrowia, Sprawności i Treningu Sportowego”. Wydarzenie to było dedykowane naukowcom, trenerom, fizjoterapeutom, dietetykom, zawodnikom oraz osobom aktywnym fizycznie. Celem konferencji była popularyzacja aktywności fizycznej w społeczeństwie oraz optymalizacja programów promocji zdrowia i procesu szkoleniowego wielu dyscyplin sportowych w oparciu o nowatorskie strategie treningowe, żywieniowo-suplementacyjne, fizjoterapeutyczno-regeneracyjne oraz ich praktyczna implikacja w procesie szkolenia sportowego i zdrowotnego. Międzynarodowy charakter konferencji naukowej umożliwił bezpośredni kontakt naukowców z trenerami i zawodnikami w celu wymiany doświadczeń oraz skonfrontowania światowej wiedzy teoretycznej z praktyką. Ponadto sesje naukowe wzbogacono o panel dyskusyjny, który pozwolił na wymianę doświadczeń pomiędzy prelegentami, a uczestnikami.

Ważnym punktem konferencji była możliwość uczestnictwa w warsztatach szkoleniowych o charakterze praktycznym dotyczących: podstaw żywienia i suplementacji, metod treningowych oraz innowacyjnych urządzeń pomiarowych wspomagających proces treningowy. Warsztaty szkoleniowe obejmowały tematykę: "Gospodarki energetycznej organizmu: określenia zapotrzebowania energetycznego oraz rozkładu makroskładników w diecie"; "Velocity based training: praktycznego monitorowania możliwości wysiłkowych zawodnika w warunkach treningowych"; "Blood flow restriction: optymalizacji parametrów stosowania metody ograniczonego przepływu krwi podczas treningu oporowego".

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Cennym elementem konferencji było także promowanie projektów i badań naukowych realizowanych w polskich i zagranicznych ośrodkach naukowych oraz szansa rozwoju szkoleniowo-badawczego początkujących adeptów w świecie nauki i sportu. Rozszerzona formuła konferencji, obejmująca sesję posterową, umożliwiła prezentację wyników badań z własnych projektów badawczych. W związku z tym mamy przyjemność przedstawić Państwu książkę abstraktów, będącą zbiorem prac prezentowanych podczas sesji posterowej naszego wydarzenia. Tematyka wystąpień obejmuje szeroki zakres zagadnień, począwszy od biomedycznych i biopsychospołecznych uwarunkowań aktywności fizycznej, poprzez analizę efektywności i optymalizacji procesów szkolenia sportowego, wychowania fizycznego, rekreacji ruchowej, aż po fizjoterapię.

Wydarzenie zostało objęte patronatem honorowym przez Ministerstwo Sportu i Turystyki, Marszałka Województwa Śląskiego oraz Prezydenta Miasta Katowice. Patronem medialnym wydarzenia została TVP3 Katowice.

Realizatorami przedsięwzięcia byli pracownicy Katedry Teorii i Praktyki Sportu wraz z członkami Studenckiego Koła Naukowego *Nutrition and Sports Performance Research Group*. Konferencja była dofinansowana ze środków budżetu państwa, przyznanych przez Ministra Edukacji i Nauki w ramach programu „Doskonała Nauka II”.

Z wyrazami szacunku

Przewodniczący Komitetu Organizacyjnego

dr Jakub Jarosz

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Ladies and Gentlemen, dear Researchers,

From the 15th to the 17th of March 2024, the International Scientific Conference titled "Novel Strategies of Enhancing Health, Fitness, and Sports Performance" took place at the Jerzy Kukuczka Academy of Physical Education in Katowice, Poland. The event was dedicated to scientists, coaches, physiotherapists, dietitians, athletes, and physically active individuals. The conference aimed to popularize physical activity in society and optimize health promotion programs along with training processes in various sports disciplines based on innovative strategies applied within training, nutrition-supplementation, recovery, and their practical implications in sports and health training. The international nature of this conference allowed direct contact among scientists, coaches, and athletes for the exchange of experiences and the confrontation of theoretical knowledge with practice. Additionally, scientific sessions were enriched with a panel discussion allowing for the exchange of experiences between presenters and participants.

An important part of the conference was the opportunity to participate in practical training workshops on the fundamentals of nutrition and supplementation, training methods, and innovative measurement devices supporting the training process. Training workshops covered topics such as "The energy demand of the human body: determining energy requirements and distribution of macronutrients in the diet"; "Velocity based training: practical monitoring of exercise capacity under training conditions"; "Blood flow restriction: optimization of the variables of applying blood flow restriction during resistance training".

A valuable element of the conference was the promotion of projects and scientific research carried out in Polish and foreign scientific centers, as well as the opportunity for the

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training and research development of aspiring novices in the world of science and sports. The expanded formula of the conference, including a poster session, allowed for the presentation of research results from their own research projects. Therefore, we are pleased to present to you the book of abstracts, which is a collection of works presented during the poster session of our event. The topics of the presentations cover a wide range of issues, from biomedical and biopsychosocial determinants of physical activity, through the analysis of the effectiveness and optimization of sports training processes, physical education, recreational physical activity, to physiotherapy.

The event was under the honorary patronage of the Ministry of Sport and Tourism, the Marshal of the Silesian Voivodeship, and the Mayor of the City of Katowice. The media patron of the event was TVP3 Katowice. The organizers of the event were the employees of the Department of Theory and Practice of Sport along with members of the students' Nutrition and Sports Performance Research Group. The conference was funded by the state budget, granted by the Minister of Education and Science as part of the "Doskonała Nauka II" program.

Yours sincerely,

Chair of the Organizing Committee

Jakub Jarosz, PhD

Deputy Chair of the Organizing Committee

Magdalena Kaszuba, MSc

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Program konferencji

15.03.2024 r. (piątek)

Warsztaty szkoleniowe o charakterze praktycznym:

| Godzina | Temat | Prowadzący |
|-------------|--|---|
| 17:00–17:45 | Velocity based training – praktyczne monitorowanie możliwości wysiłkowych zawodnika w warunkach treningowych (Siłownia Nowa Hala AWF) | dr hab. Michał Wilk, prof. AWF mgr Dawid Gaweł |
| 18:00–18:45 | Gospodarka energetyczna organizmu – określenie zapotrzebowania energetycznego oraz rozkładu makroskładników w diecie (Sala 210 Nowa Hala AWF) | dr Mateusz Gawełczyk |
| 19:00–19:45 | Blood flow restriction – optymalizacja parametrów stosowania metody ograniczonego przepływu krwi podczas treningu oporowego (Siłownia Nowa Hala AWF) | dr hab. Michał Krzysztofik, prof. AWF dr Jakub Jarosz |

16.03.2024 r. (sobota)

| Godzina | Temat | Prowadzący |
|-----------|---|------------|
| 8:00–9:00 | Rejestracja uczestników (Aula, budynek główny AWF) | |

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| POWITANIE I OTWARCIE KONFERENCJI (Aula, budynek główny AWF) | | |
|---|--|---|
| 9:00–9:15 | | |
| 9:15–9:45 | Alternatywne ćwiczenia oporowe w kształtowaniu szybkości sprinterskiej | prof. Adam Zając, dr Miłosz Drozd |
| 9:45–10:15 | Periodyzacja w oparciu o tempo ruchu oraz wskaźnik TUT | dr hab. Michał Wilk prof. AWF |
| 10:15–10:45 | Novel power training approaches for team sports | prof. Gregory Bogdanis |
| 10:45–11:00 | Przerwa kawowa | |
| 11:00-11:30 | Siła w Kontraście: skuteczne strategie Complex-Contrast Training | dr hab. Michał Krzysztofik prof. AWF |
| 11:30–12:00 | Development of ice hockey general and specific conditions during growth and maturation | prof. Petr Stastny |
| 12:00–12:30 | Złożona rzeczywistość treningu oporowego w sporcie wyczynowym | dr hab. Hubert Makaruk prof. AWF |
| 12:45–14:00 | SESJA POSTEROWA (Nowa Hala AWF) | |
| 14:00–15:15 | Przerwa obiadowa (Nowa Hala AWF) | |
| 15:30–16:00 | Precompetition strategies to enhance performance | mgr Dominik Kolinger |
| 16:00–16:30 | Trening siły mięśniowej, wzorce ruchu, przygotowanie motoryczne | dr hab. Artur Gołaś, prof. AWF |

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| | | |
|-------------|---|-----------------------|
| 16:30–17:00 | Analysis of relationships between strength, power and physical match performance in elite soccer players | prof. Tomas Maly |
| 17:00–17:30 | Eccentric exercise training with a flywheel device: effects on health and performance | dr Athanasios Tsoukos |
| 17:30–18:00 | Decoding Physical Potential: A Genomic Path to Personalized Exercise Regimens | dr Miroslav Petr |
| 18:00–18:30 | Wykorzystanie metody kontrastowej w kształtowaniu mocy mięśniowej kończyn dolnych w ekstralidze piłki nożnej kobiet | dr Mariola Gepfert |
| 18:30 | PANEL DYSKUSYJNY (AWF Katowice) | |

17.03.2024 r. (niedziela)

| Godzina | Temat | Prowadzący |
|-------------|---|--|
| 10:00–10:30 | Kofeina – jeden suplement, wiele możliwości. Caffeine | dr Aleksandra Filip-Stachnik, mgr Magdalena Kaszuba |
| 10:30–11:00 | Medyczne i prawne konsekwencje treningu kształtowania siły mięśniowej | prof. Krzysztof Ficek, mec. Igor Płaza |
| 11:00–11:30 | The sleep of elite athletes: implications for performance | dr Jacopo Vitale |

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| 11:30–12:00 | Effects of training in different locations on some physiological parameters involved in increasing running performance | dr Dan Iulian Alexe |
| 12:00–12:30 | Przerwa kawowa | |
| 12:30–13:00 | Praktyczne elementy stosowania ograniczenia przepływu krwi | dr Marta Bichowska, mgr Krzysztof Fostiak |
| 13:00–13:30 | Supercompensation: about physiological mechanisms of programming the training process | dr hab. Jakub Chycki, prof. AWF |
| 13:30–14:00 | Sen u sportowców. Jak śpią i dlaczego wciąż tak mało? | dr Aleksandra Filip-Stachnik, mgr Zuzanna Komarek |
| 14:00–14:30 | Wpływ aktywacji izometrycznej na wystąpienie i powtarzalność efektu PAPE w trakcie sezonu w piłce nożnej | dr Jakub Jarosz |
| 14:30–14:45 | Podsumowanie konferencji, podziękowanie i zamknięcie konferencji | |

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Conference programme

15.03.2024 (Friday)

Practical training workshops:

| Time | Topic | Presenter |
|-------------|--|---|
| 17:00–17:45 | Velocity based training – praktyczne monitorowanie możliwości wysiłkowych zawodnika w warunkach treningowych (Siłownia Nowa Hala AWF) | dr hab. Michał Wilk, prof. AWF mgr Dawid Gaweł |
| 18:00–18:45 | Gospodarka energetyczna organizmu – określenie zapotrzebowania energetycznego oraz rozkładu makroskładników w diecie (Sala 210 Nowa Hala AWF) | dr Mateusz Gawełczyk |
| 19:00–19:45 | Blood flow restriction – optymalizacja parametrów stosowania metody ograniczonego przepływu krwi podczas treningu oporowego (Siłownia Nowa Hala AWF) | dr hab. Michał Krzysztofik, prof. AWF dr Jakub Jarosz |

16.03.2024 (Saturday)

| Time | Topic | Presenter |
|-----------|---|-----------|
| 8:00–9:00 | Registration of participants (Aula, main building AWF) | |

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| | | |
|-------------|--|---|
| 9:00–9:15 | WELCOME AND OPENING OF THE CONFERENCE (Aula, main building AWF) | |
| 9:15–9:45 | Alternatywne ćwiczenia oporowe w kształtowaniu szybkości sprinterskiej | prof. Adam Zając, dr Miłosz Drozd |
| 9:45–10:15 | Periodyzacja w oparciu o tempo ruchu oraz wskaźnik TUT | dr hab. Michał Wilk prof. AWF |
| 10:15–10:45 | Novel power training approaches for team sports | prof. Gregory Bogdanis |
| 10:45–11:00 | Coffee Break | |
| 11:00–11:30 | Siła w Kontraście: skuteczne strategie Complex-Contrast Training | dr hab. Michał Krzysztofik prof. AWF |
| 11:30–12:00 | Development of ice hockey general and specific conditions during growth and maturation | prof. Petr Stastny |
| 12:00–12:30 | Złożona rzeczywistość treningu oporowego w sporcie wyczynowym | dr hab. Hubert Makaruk prof. AWF |
| 12:45–14:00 | POSTER SESSION (New Hall AWF) | |
| 14:00–15:15 | Lunch Break (New Hall AWF) | |
| 15:30–16:00 | Precompetition strategies to enhance performance | mgr Dominik Kolinger |
| 16:00–16:30 | Trening siły mięśniowej, wzorce ruchu, przygotowanie motoryczne | dr hab. Artur Gołaś, prof. AWF |

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|-------------|---|-----------------------|
| 16:30–17:00 | Analysis of relationships between strength, power and physical match performance in elite soccer players | prof. Tomas Maly |
| 17:00–17:30 | Eccentric exercise training with a flywheel device: effects on health and performance | dr Athanasios Tsoukos |
| 17:30–18:00 | Decoding Physical Potential: A Genomic Path to Personalized Exercise Regimens | dr Miroslav Petr |
| 18:00–18:30 | Wykorzystanie metody kontrastowej w kształtowaniu mocy mięśniowej kończyn dolnych w ekstralidze piłki nożnej kobiet | dr Mariola Gepfert |
| 18:30 | DISCUSSION PANEL (AWF Katowice) | |

17.03.2024 (Sunday)

| Time | Topic | Presenter |
|-------------|---|--|
| 10:00–10:30 | Kofeina – jeden suplement, wiele możliwości. Caffeine | dr Aleksandra Filip-Stachnik, mgr Magdalena Kaszuba |
| 10:30–11:00 | Medyczne i prawne konsekwencje treningu kształtowania siły mięśniowej | prof. Krzysztof Ficek, mec. Igor Płaza |
| 11:00–11:30 | The sleep of elite athletes: implications for performance | dr Jacopo Vitale |

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|-------------|--|--|
| 11:30–12:00 | Effects of training in different locations on some physiological parameters involved in increasing running performance | dr Dan Iulian Alexe |
| 12:00–12:30 | Coffee Break | |
| 12:30–13:00 | Praktyczne elementy stosowania ograniczenia przepływu krwi | dr Marta Bichowska, mgr Krzysztof Fostiak |
| 13:00–13:30 | Supercompensation: about physiological mechanisms of programming the training process | dr hab. Jakub Chycki, prof. AWF |
| 13:30–14:00 | Sen u sportowców. Jak śpią i dlaczego wciąż tak mało? | dr Aleksandra Filip-Stachnik, mgr Zuzanna Komarek |
| 14:00–14:30 | Wpływ aktywacji izometrycznej na wystąpienie i powtarzalność efektu PAPE w trakcie sezonu w piłce nożnej | dr Jakub Jarosz |
| 14:30–14:45 | Summary of the conference, thanks and closing of the conference | |

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ABSTRAKTY SESJA POSTEROWA

ABSTRACTS POSTER SESSION

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Effect of the time of cold & heat contrast compression therapy on biomechanical changes in forearm muscles in MMA fighters: a prospective, interventional, single-blinded, clinical pilot study

Robert Trybalski^{1,2}, Arkadiusz Stanula³, Andriy Vovkanych⁴, Tomasz Halski⁵, Małgorzata Paprocka-Borowicz⁶, Robert Dymarek⁶, Jakub Taradaj⁷

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⁴Department of Physical Therapy and Ergotherapy, Ivan Boberkyj Lviv State University of Physical Culture, Lviv, Ukraine

⁵Department of Physiotherapy, Jan Grodek State University, Sanok, Poland,

⁶Department of Physiotherapy, Wrocław Medical University, Wrocław, Poland

⁷Institute of Physiotherapy and Health Sciences, Academy of Physical Education in Katowice, Katowice, Poland

Introduction: Various cold and heat therapies for recovery in sports are commonly used, also in the MMA. An example of such therapy is the Game Ready (GR) device which can be used both for local monotherapy with either heat or cold and for contrast therapy. So far, there have been no studies evaluating biomechanical changes in muscles in relation to the duration of GR therapy. This study aimed to evaluate the effects of GR therapy time on muscle tone, muscle stiffness and elasticity, pressure pain threshold, tissue perfusion, and muscle force.

Materials and methods: This prospective single-blind clinical study involved a group of 20 MMA volunteers with mean age of 26.5 ± 4.5 years and training experience of 10.3 ± 5.0 years. The study tested three different GR study phases: (1) provided with a stimulation time of 10 minutes (eGR-10), (2) with 20 minutes (eGR-20), and (2) the control using sham GR therapy (cGR). Participants were

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stimulated every seven days with GR therapy. The following outcomes were assessed: muscle tone (T), stiffness (S), elasticity (E), pressure pain threshold (PPT), microvascular response described in non-reference units (PU) and maximum isometric force (F_{max}). All measurements were taken before GR (Rest) and after GR stimulation (Post).

Results: In terms of PU, both after eGR-10 and eGR-20, the differences compared to the measurements made at rest were statistically significantly ($p < 0.001$) higher, (greater effect was obtained after eGR-20). In terms of F_{max} , statistically significant differences ($p < 0.001$) were observed between the values recorded at rest and after eGR-10 and eGR-20 (Cohen's d effect sizes were larger in the eGR-20). A statistically significant ($p < 0.001$) decrease in the value of the T parameter was observed, both in the eGR-10 and eGR-20 (greater decreases were observed in the eGR-10). A similar tendency was observed in the S parameter, for which both in the eGR-10 and eGR-20, a statistically significant ($p < 0.001$) decrease after the therapy was observed. Both in the eGR-10 and eGR-20, a statistically significant ($p = 0.001$ and $p < 0.001$, respectively) decrease in the E value was observed. In terms of PPT, statistically significant differences ($p < 0.001$) were observed between the values recorded at rest and after eGR-10 and eGR-20 (Cohen's effect sizes were larger in the eGR-20).

Conclusions: This study provides evidence that GR is a stimulus that can influence muscle biomechanical changes, pain threshold, muscle strength, and tissue perfusion.

Trial registration: The study was registered with the number ISRCTN90040217, registration date: 25/05/2023; <https://www.isrctn.com/ISRCTN90040217>

Keywords: MMA fighters, biomechanical outcomes, tissue perfusion, myotonometry, pressure pain threshold, maximum muscle force

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Acute impact of foam rolling and tissue flossing on thigh muscles: effects on jump performance and muscle viscoelasticity

Anna Pisz, Dusan Blazek, Petr Stastny

Faculty of Physical Education and Sport, Department of Sports Games, Charles University, Prague, Czech Republic

Introduction: Nowadays, various methods are used for acute performance enhancement. Among these, tissue flossing (TF) is gaining traction as a technique for both performance improvement and rehabilitation. Despite its growing use, the impact of TF on athletic performance remains unclear, possibly due to methodological variations. Additionally, there has been limited research comparing TF with foam rolling (FR), another widely used technique (1). Thus, this study aims to evaluate and contrast the efficacy of TF and FR in terms of their effects on range of motion (ROM), jump performance, and the viscoelastic characteristics of the muscle.

Materials and Methods: A cross-over design of the study was applied, where 30 male handball players underwent three types of conditioning: tissue flossing (TF), foam rolling (FR) or control (CON). The study used a comprehensive methodology that included an active knee extension test, jump performance evaluation (measured using force plates), and assessment of viscoelastic properties of the Biceps Femoris (BF), Rectus Femoris (RF) and Vastus Lateralis (VL) of both legs. Participants were measured before conditioning and respectively in the 2nd and 15th min after conditioning activity. Two-way repeated measures ANOVA was used to evaluate the data.

Results: TF and FR significantly improved ROM in both legs when compared to the CON, however, no significant differences occurred between any of the conditions. Jump height

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experienced a significant drop post-intervention in the FR group, while no changes were observed for TF and the control group. The Braking Rate of Force Development showed significant improvement in the TF group when comparing pre and post max value. ANOVA revealed no significant differences between the interventions in measurements of viscoelastic properties, and none of the interventions showed significant improvements when compared to the control condition. However, TF decreased significantly muscle stiffness in the right VL and both RF, whereas FR significantly decreased muscle stiffness and muscle tone in all muscles.

Conclusions: Our findings indicate that tissue flossing did not demonstrate superior improvements in ROM, muscle tone and stiffness, or jump performance compared to foam rolling. However, both tissue flossing and foam rolling led to significant improvements in hamstring flexibility. Considering that FR had a negative impact on jump height performance, but both were effective in improving hamstring flexibility, it is reasonable to suggest that a method to be included in a warm-up routine should be carefully selected based on the exercise objective. Athletes and individuals can choose either tissue flossing or foam rolling based on personal preference, accessibility or specific goals. It is important to note that individual responses to these techniques may vary, and some individuals may find one of these methods more effective or suitable for their needs.

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Keywords: tissue flossing, foam rolling, jump performance

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The effectiveness of resistance exercises performed on stable and unstable surfaces in relation to torso activation

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Introduction: Deep stabilization system (DSS) strength and endurance are important components of training programs not only for injury prevention but also for maximizing athletic performance (1,2). Training surfaces can influence training outcomes; therefore, this study aimed to compare the impact of performing strength trunk exercises on unstable and stable surfaces with conventional trunk exercises.

Materials and methods: A counterbalanced crossover study design was used to assess the effect of different trunk strengthening exercises on DSS stability among 20 elite futsal players. Each variant was practiced during one-year training cycle in the preparatory period (in total 3 years) for 10 weeks with a frequency of 2–3 times a week. The training unit usually lasted between 35 and 45 min. A total amount of 25 interventions were completed per year, and 75 during all the study period. The first variant (CE) focused on the conventional isolated exercises: lying sit-ups, crunches, and their modifications. The second variant (US) consisted of complex excises of a new type on labile aids. The third variant (SS) was similar to the US variant with the only difference being that it was performed entirely on stable mats. All exercises in variant CE were performed at a tempo of 1-0-1-0, where the individual numbers successively represent the eccentric, the maximum eccentric, the concentric, and the maximum concentric phase of the main agonist muscle. The US variant on a labile pad and the SS variant on

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a stable pad were performed at a tempo of 2-2-2-0. However, the TUT (Time Under Tension) was always the same for all variants, as more repetitions were included in the CE variant. The total loading time for all exercises ranged from 20 to 40 s. Initial testing was performed each year before the start of the intervention, followed by control measurement after 5 weeks and final measurement after 10 weeks. Pre- and post-tests encompassed various measurements, including diaphragm, trunk flexion, trunk back extension, hip flexion, intraabdominal pressure, side plank, pronation, and supination tests (3).

Results: Conventional exercises showed a significant improvement only in the side plank test. In contrast, un-stable and stable surface conditions led to notable enhancements in all test performance, displaying superior trunk stability compared to conventional exercises. The stable surface condition demonstrated significantly greater improvements in the pronation and supination tests compared to the unstable surface condition.

Conclusions: Except for the side plank test, dynamic conventional exercises did not yield substantial improvements in the assessed tests. Deep stabilization system training enhances trunk stability when performed on both unstable and stable surfaces, with unstable surfaces potentially yielding greater improvements in m. transversus stabilization functions.

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Keywords: dynamic stabilization system strengthening, unstable surface training, core training

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Total Immersion freestyle as a determinant of faster and more economical swimming

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Introduction: The Total Immersion method is based on fundamental factors such as balance, streamlining and propulsion. The basic rule of Total Immersion is compatibility with the aquatic environment (1,2). The purpose of this study is to compare the progression of crawl swimming technique taught students using the traditional method versus the Total Immersion method, and to examine whether swimming with the TI technique is more effective than the traditional technique.

Materials and methods: Two groups participated in the research. The first group consisted of 100 students perfecting their crawl swimming with the traditional method (MT), while the second research group consisted of 100 students perfecting their crawl swimming with the TI(MTI) method. Both research groups took part twice in the 4 x 25-m walk test, conducted on a 25-m swimming pool. Then, for 4 weeks, one research group perfected swimming with the traditional crawl method, the other with the TI method. After 15 weeks, the 4 x 25-m walk test was repeated in each research group. Time was measured only in the 15-m swimming zone, between the turnaround flags. Two stopwatches were used during the research. The first was used to measure the time taken to complete a 15-m swimming distance and the second to

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measure the duration of 3 cycles. Also analyses were carried out using the Mann-Whitney U test and the Wilcoxon test.

Results: Statistically significant differences were observed between the swimming speed before and after the research in the MTI group. Statistically significant differences were shown between the movement frequency before and after the intervention in the MTI group. Significant differences were found between cycle length before and after the intervention in the TI group. Statistically significant differences were observed between the technique index before and after the research in the MTI group.

Conclusions: There were statistically significant changes in the results of the examined kinematic variables in the group taught by the traditional method versus the TI method. The group taught by the TI method achieved better speed and the duration of the 3 cycles increased, making the length of one cycle longer. The value of the technique also improved significantly. In the examined variable parameters of swimming technique, TI teaching gave better results. The value of the swimming technique index improved significantly and thus the economy of swimming increased (3).

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Keywords: swimming technique index, swimming speed, swimming cycle length

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Comprehensive technical analysis of K1 Kickboxing fights based on match observation

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Introduction: Observation and specialized analysis of confrontations in combat sports form the basis for introducing corrections in training programs and modifying the individual technical-tactical profiles of athletes engaged in such activities. These actions comprehensively assess the course of sports activities, ultimately inspiring and determining the direction of training in sports clubs. The objective of this study was to analyze and evaluate the level of offensive structure in sports combat, specifically in kickboxing under the K1 format, with a global perspective on simulated sparring sessions, within selected thematic comparisons.

Materials and methods: The research material consisted of multimedia recordings of 10 simulated K1 sparring sessions, involving 20 high-performance athletes in this discipline (age: 24.5 ± 4.6 years; height: 179.1 ± 4.6 cm; body weight: 81.7 ± 9.9 kg; BMI: 25.5 ± 3.7 ; training experience: 6.9 ± 1.3 years). To assess the offensive structure of the combat, a retrospective analysis of the recorded empirical data was conducted, quantifying the executed attacks. Subsequently, specialized indicators of technical-tactical preparation (PTT) were calculated, considering the global perspective of sparring, within thematic comparisons (overall; punches vs kicks; attacks on the right vs left limbs; types of techniques; direction of attack).

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Results: During the analysis, a significantly higher technical-tactical efficiency was observed for hand strikes, left-hand techniques, and the direction of strikes to the opponent's head for activity ($p < 0.001$), effectiveness ($p < 0.001$), and efficiency ($p = 0.008-0.408$) of the attack. Isolating kicking techniques revealed a significant advantage in efficiency for selected attacks targeting the lower parts of the opponent's body, such as the torso and legs ($p \leq 0.001-0.043$). The most effective and frequently used techniques were the left straight punch ($Aa \bar{x} = 36.8$; $Sa \bar{x} = 23.9$), while in the context of kicks, the right low kick ($Aa \bar{x} = 14.9$; $Sa \bar{x} = 5.6$) showed prominence. The highest attack efficiency was noted for the right middle kick ($Ea \bar{x} = 54.18$). Several selected comparative sets (inter-limb symmetry, type of attack, direction of attack) for technical-tactical efficiency were characterized by significant statistical differences ($p \leq 0.001-0.048$).

Conclusions: Kickboxing is an asymmetrical combat sport, necessitating the implementation of targeted training for specific body segments of the athlete and compensatory actions in injury prevention. The research results enable a detailed diagnosis and interpretation of the technical-tactical profile, along with the key manifestation of offensive competencies in kickboxing, particularly in the K1 format. This contributes to optimizing the quality of coaching control.

Keywords: combat sports, offensive combat analysis, technical-tactical indicators

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The impact of omega-3 fatty acid supplementation on the composition of erythrocyte membranes

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Introduction: Omega-3 fatty acids, such as EPA and DHA, not only influence the body's ability to control inflammatory processes and regulate blood pressure, but they also play a crucial role in shaping the structure of cell membranes. Consuming these acids, which the body does not produce independently, is essential for maintaining the integrity and flexibility of cells, a factor that is significant for overall health. The aim of the study was to assess the influence of a five-month supplementation with omega-3 fatty acids on the composition of fatty acids in erythrocyte membranes. The study involved a detailed biochemical analysis of erythrocyte membranes.

Materials and methods: The study involved a 31-year-old professional football player, standing at 192 cm tall and weighing 82 kg, serving as a goalkeeper. Over a period of 5 months, the participant consumed a dietary supplement containing omega-3 fatty acids. The supplement dosage was 4956 mg of omega-3 fatty acids (2566 mg EPA and 1366 mg DHA). The supplement included fish oil, olive oil, antioxidants, and 40 µg of vitamin D3. The consumed supplement was "Balance Oil" from the ZINZINO company. Throughout the supplementation period, the participant maintained a balanced mixed diet providing his daily energy requirements. The football player trained five times a week, with training sessions lasting an

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average of three hours per day. During the supplementation period, he participated in nine matches in the top league. After five months, on April 4, 2023, a fasting blood sample was collected to thoroughly examine the impact of the omega-3 supplement on the composition and erythrocyte membranes. During this period, the estimated caloric intake of the athlete was 3200 kcal, with a concurrent percentage of body fat content at 11%.

Results: The results indicated significant changes in the composition of erythrocyte membranes. Omega-3 supplementation improved the levels of fatty acids, normalizing alpha-linolenic acid (C18:3) to 0.39%, mitigating the deviation of eicosapentaenoic acid (EPA, C20:5) by -46.8%, and increasing the content of docosahexaenoic acid (DHA, C22:6) to 3.43%. The omega-6 to omega-3 ratio also significantly improved, approaching the normal range, and the omega-3 index increased to 5.2%, nearing the target level. The supplementation-induced improvement in erythrocyte membrane fluidity reached a ratio of 7.2:1.

Conclusions: Omega-3 fatty acid supplementation had a positive impact on the composition of erythrocyte cell membranes. The significant increase in the concentration of unsaturated fatty acids likely minimally enhanced their fluidity, potentially favorably affecting the permeability of nutrients. Omega-3 supplementation led to an increase in the levels of alpha-linolenic acid, eicosapentaenoic acid, docosapentaenoic acid, and docosahexaenoic acid, although they did not always reach normative levels. The omega-6 to omega-3 ratio and membrane fluidity index both improved after five months of supplementation. In summary, Omega-3 fatty acid supplementation proved to be significant in maintaining the balance of fatty acids in erythrocyte cell membranes, positively influencing their functions and overall organism homeostasis.

Keywords: omega-3, omega-3 fatty acid supplementation, erythrocyte cell membranes

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The effect of contrast training on strength and speed in ice hockey players

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Introduction: Ice hockey is a contact sport characterized by high intensity and interval action, requiring large physical expenditure affecting the neuromuscular and cardiovascular systems (1). It requires players to repeatedly develop strength, speed, agility and excellent stick technique, as well as the willingness to absorb physical contact (2). The aim of the experiment was to determine the effect of contrast training on the level of strength and speed in ice hockey players.

Materials and methods: The study involved 30 male ice hockey players (two hockey teams playing in the MHL—Młodzieżowa Hokej Liga). One team ($n = 15$) performed contrast training while the other team ($n = 15$) performed traditional strength training. Before and after the 8-week training period, the subjects performed tests of maximum strength (back squat, deadlift, bench press), jumping ability and speed tests on ice (30-m sprint test, slap shooting speed). Analysis of variance (ANOVA) with repeated measures was used to assess differences in selected variables.

Results: Repeated measures ANOVA showed a statistically significant effect of training on maximum strength in the back squat ($F_{1,28} = 44.276, p = 0.000, \eta^2 = 0.613$), deadlift ($F_{1,28} =$

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48.128, $p = 0.000$, $\eta^2 = 0.632$) and bench press ($F_{1,28} = 44.978$, $p = 0.000$, $\eta^2 = 0.445$) exercises. Also, the same situation occurred in tests on ice, where after training there was a significant increase in shooting speed ($F_{1,28} = 73.407$, $p = 0.000$, $\eta^2 = 0.724$) and a 30-m sprint test ($F_{1,28} = 15.347$, $p = 0.001$, $\eta^2 = 0.354$). Additionally, the Bonferroni post-hoc test showed a significantly greater increase in strength after contrast training than after traditional strength training in tests such as the back squat ($p = 0.000$), deadlift ($p = 0.000$) and bench press ($p = 0.000$).

Conclusions: Contrast training among ice hockey players enables greater training adaptation, which translates into achieving better results on ice. Simultaneous improvement of activities such as skating sprint or shot speed can have a direct impact on the game result.

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Keywords: athletic performance, exercise test, muscle strength

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The effectiveness of motor control training in treating patients with chronic low back pain

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Introduction: In individuals suffering from chronic low back pain, changes occur at the central nervous system level. It leads to motor control impairment and numerous patients movement restrictions. A comprehensive therapy plan requires a global perspective and an analysis of the patient's movement and functional efficiency. The aim of the study was to determine the effectiveness of a developed motor training program on improving motor control skills, quality and technique of performing functional patterns and increasing the functional efficiency of the participants while decreasing their pain level.

Materials and methods: Twenty-four women (age: 20–24 years) with reported low back pain who took part in research were randomly assigned to two equivalent groups (n = 12). Group 1 participated in a 12-week functional, Lumbo-Pelvic-Hip Complex training program. Group 2 was the control group, without any form of intervention. All measurements were conducted twice, before and after 12 weeks. To identify deficits in movement control, a research protocol FTPKCMSI was developed. To assess functional efficiency, the FMS screening test which evaluates seven fundamental movement patterns was used. Three-dimensional motion analysis

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system BTS SMART-D allowed for a quantitative assessment of forward trunk flexion movement technique by determining changes in angular relationships over time. Pain levels were evaluated using the VAS Scale. Due to the nature of the variables, for statistical analysis both parametric and non-parametric significance tests were used. Statistical significance was set at $p < 0.05$. Results were also interpreted based on percentage calculations.

Results: In the group of women participating in motor control training (Group 1), a statistically significant improvement ($p < 0.05$) was observed in the quality of executing the functional movement pattern. Based on the results of the FTPKCMSI protocol, an improvement was observed in controlling the prescribed movements and muscle work efficiency. A significantly higher level of functional efficiency was noted in the FMS tests. There were also significant changes in the values of the angular relationships in individual segments during the forward bending movement. The proposed training program notably decreased the pain level from 5.5 to 1.7. The obtained results were significantly superior compared to the control group, where no significant differences were noted in the second assessment.

Conclusions: The implementation of motor training has proven to be an effective form of therapy. A deeper understanding the pathophysiology of existing movement disorders may contribute to the physiotherapist or trainer's development of personalized therapeutic programs that includes the specific movement deficits of patients.

Keywords: lumbar spine, functional assessment, motor control

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Relationships between lower extremity strength and mechanical performance in force-velocity tests among amateur cyclists

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Introduction: Sprint performance in cycling depends on peak power output (PPO). In turn, PPO is determined by different factors, especially mechanical properties (Hill's force-velocity relationship) e.g., maximal torque. Different sport-specific tests (conducted on a cycle-ergometer) or non-specific tests are performed to assess the ability of the lower extremities to generate maximal strength (isokinetic torque) and power (countermovement jump). However, there is a lack of evidence regarding how different lower extremity muscle strength characteristics influence mechanical performance in amateur cyclists. This study aimed to investigate the relationships between mechanical variables from the sprint cycling performance test (SCPT) and isokinetic peak torque of lower extremities muscle strength.

Materials and methods: Twenty amateur male cyclists, age: 26.6 ± 6.2 (years), height: 1.78 ± 0.6 (m), body mass: 78.2 ± 8.7 (kg), training experience: 7 ± 5 (years) participated in this research and performed three tests. First, a sprint cycling performance test (using a Lode cycle-ergometer) was conducted to determine peak power output, maximal extrapolated torque (T0), optimal torque (TOPT), maximal extrapolated cadence (C0), and optimal cadence (COPT). The SCPT consisted of five 4-s all-out sprints with 115, 60, 135, 125, and 180 RPM with a 5-minute passive rest. Next, a countermovement jump test (CMJ) was performed using a Kistler

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dynamometric platform (three jumps). This was followed by measuring the peak torque of the knee and hip flexors and extensors on a Biodex isokinetic dynamometer at speeds 60, 90, 120, and 180 degrees·s⁻¹. The highest peak torque values for each muscle group were selected for further analysis, and the Pearson correlation coefficient (*r*) was calculated.

Results: Maximal extrapolated torque was strongly correlated with peak power output ($r = 0.80$, $p < 0.001$). Strong relationships ($r = 0.74$, $p < 0.001$) were found between the PPO and hip and knee flexors, also slightly lower for knee extensors ($r = 0.71$, $p < 0.001$), while hip extensors were $r = 0.59$ ($p < 0.01$). T0 was correlated with knee extensors and flexors, $r = 0.63$ and $r = 0.61$ (both $p < 0.05$), respectively. Similarly, optimal torque was correlated with knee extensors ($r = 0.66$, $p < 0.01$) and flexors ($r = 0.65$, $p < 0.05$). Moreover, strong relationships were found between the CMJ and PPO ($r = 0.85$, $p < 0.001$), as well as for the CMJ and COPT ($r = 0.85$, $p < 0.001$).

Conclusions: The evidence suggests that lower extremity strength has an important role in determining the mechanical sprint performance of amateur cyclists. Particularly, cyclists should focus on knee flexors and extensor training to improve their high-intensity effort performance.

Keywords: sprint cycling, peak power output, torque

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Relationships between mechanical performance and lower extremity strength in repeated cycling sprints

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Introduction: Repeated sprint ability (RSA) depends on various factors, including maximal oxygen uptake, buffering capacity, and phosphocreatine resynthesis. These factors are associated with the high demands of energy systems contribution and the ability to sustain maximal intensity during consecutive efforts. One crucial aspect of RSA is the quality of a single sprint, which indicates the role of mechanical peak power output (PPO) and its main determinants. Peak power output is influenced by various factors, especially mechanical properties such as Hill's force-velocity relationship, for example, maximal torque. Therefore, it is intriguing to evaluate how different characteristics of lower extremity muscle strength influence repeated sprint cycling ability in amateur individuals. This study aimed to investigate the relationships between performance in repeated sprint cycling conducted at optimal cadence and the isokinetic peak torque of lower extremity muscle strength.

Materials and methods: Twenty amateur male cyclists, age: 26.6 ± 6.2 (years), height: 1.78 ± 0.6 (m), body mass: 78.2 ± 8.7 (kg), training experience: 7 ± 5 (years) participated in this research and performed three following tests. First, a sprint cycling performance test (SCPT) (using a Lode cycle-ergometer) was conducted to determine peak power output, maximal extrapolated torque (T0), optimal torque (TOPT), maximal extrapolated cadence (C0), and

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optimal cadence (COPT). The SCPT consisted of five 4-s all-out sprints with 115, 60, 135, 125, and 180 RPM with a 5-min passive rest. Next, a repeated sprint cycling (RSC) at optimal cadence, which included 15 x 4-s all-out iso-velocity bouts with 60 s passive rest, was carried out on the same ergometer. This was followed by measuring the peak torque of the knee and hip flexors and extensors on a Biodex isokinetic dynamometer at speeds 60, 90, 120, and 180 degrees·s⁻¹. The highest peak torque values for each muscle group were selected for further analysis, and the Pearson correlation coefficient (*r*) was calculated.

Results: Average power achieved in the RSC strongly correlated with PPO ($r = 0.89, p < 0.001$), T0 ($r = 0.76, p < 0.001$) and TOPT ($r = 0.79, p < 0.001$) derived from the SCPT. Additionally, the correlation analysis revealed strong relationships between mechanical performance in the RSC and peak torque of the hip flexors ($r = 0.81, p < 0.001$), knee flexors ($r = 0.84, p < 0.001$) and knee extensors ($r = 0.85, p < 0.001$).

Conclusions: These findings suggest that the performance in repeated sprint cycling is strongly related with different strength indices of lower limbs. Moreover, a measure of cycling specific strength as maximal torque can be a stronger prediction of repeated sprint cycling performance.

Keywords: sprint cycling, optimal cadence, average power

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Off-ice muscle strength power correlation with on-ice performance of selected activities

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Introduction: Ice hockey is a team sport characterised by an intense physical effort that combines the technical skills of skating together with the explosive actions of the lower limbs (acceleration, change of direction) and the upper body (shot, pass). Therefore, the determinants and relationships between specific performance and various motor properties such as muscular strength, acceleration or locomotor speed are sought. Due to the long ice hockey league season, it is believed that players should shape their motor skills off the ice and select exercises accordingly to translate them into performance during specific actions on the ice and moving on skates. The aim of this study was to determine the relationship between selected strength parameters measured on land and performance on ice in hockey players.

Materials and methods: Thirty ice hockey players participated in the study, with an age of 17.8 ± 1.3 (year), body height of 181.7 ± 4.7 (cm) and body weight of 78.5 ± 8.5 (kg). In the study the following strength level tests were performed on land to determine 1 repetition maximum (1RM): bench press, back squat and deadlift. Lower limb power was determined by the countermovement jump with hands on hips, and performance tests were performed on ice, slap shot, and skating for 30 m. Pearson's correlation coefficient (r) was calculated.

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Results: The analysis performed indicates a significant correlation between the bench press and the slap shot ($r = 0.66, p = 0.00$), the countermovement jump and the 30-m skating test ($r = -0.41, p = 0.01$) and the back squat and the slap shot ($r = 0.30, p = 0.19$). There was no correlation between the deadlift and the slap shot and skating for 30 m.

Conclusions: Ice hockey coaches wishing to increase their team's performance of, among other things, the skating for 30 m acceleration and the slap shot should supplement their on-ice training with exercises off-ice such as the bench press, the back squat and the countermovement jump.

Keywords: performance, ice skating, ice hockey expertise

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Comparison of strength and speed characteristic between two young ice hockey teams with a similar sports level

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Introduction: Ice hockey is a physically demanding, high-intensity sport where skating skills play an important role. Players must have excellent physical conditioning and also a high level of muscle strength, which has an impact on the player's performance during the game. However, little research has been conducted on young age hockey players to analyse relevant key performance indicators. The aim of the study was to determine the differences in the level of strength and speed on-ice and off-ice in two male hockey teams.

Material and methods: The study involved 60 young male ice hockey players (two hockey teams playing in the MHL – Młodzieżowa Hokej Liga). The first team had a mean age of 18.7 ± 0.9 [years]; body height of 183.2 ± 4.9 [cm] and weight of 81.9 ± 9.2 [kg]. The second team had a mean age of 17 ± 0.7 [years]; body height of 180.5 ± 4.1 [cm] and weight of 75 ± 5.4 [kg]. To assess strength and speed potential, the following off-ice tests were used: back squat, deadlift, bench press and countermovement jump (CMJ), and on-ice tests: 30-m sprint and slap shot speed. The T-student test for independent samples was used to assess differences in selected variables.

Results: The off-ice results were as follows: maximum strength in the bench press test differed significantly between teams ($p = 0.000$, $t = -6.088$), the same situation occurred in the deadlift

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test ($p = 0.019$, $t = 2.407$). At the same time, there were no significant differences between the teams in the back squat test ($p = 0.288$, $t = -1.073$). The CMJ test also showed no significant differences between the teams ($p = 0.148$, $t = 1.465$). The on-ice results were as follows: slap shot speed differed significantly between teams ($p = 0.000$, $t = -6.391$), while there were no differences in the 30-m sprint test ($p = 0.324$, $t = 0.996$).

Conclusions: Statistically significant differences were found between the teams in the bench press, deadlift and also in the slap shot. The reason for this may be the different training approach at the two clubs in strength and conditioning training of the players.

Keywords: ice skating, performance, strength and conditioning

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Sex differences in the somatic structure and physical fitness of young weightlifters

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Introduction: Research has shown that sex-specific anthropometric and physical performance differences align with findings from studies on sexual dimorphism, indicating higher absolute and relative strength levels in boys compared to girls. Moreover, the average differences between men and women results in the London 2012 Olympic games with the same or similar body weight was $23 \pm 3.7\%$ (Szabo et al., 2013). Additionally, based on 3-class average (55, 81 and super heavyweight category) the differences between male and female medalists in the snatch were 22.7–35.1%, and in the clean and jerk (C&J), 21.5–32.5% (Pierce et al., 2021). The aim of this study is to investigate the differences in somatic structure and physical fitness between young male and female weightlifters.

Materials and methods: A total of 53 young weightlifters (25 females, 28 males), with an average age of 14.5 ± 0.93 years, were recruited from six clubs affiliated with the Polish Weightlifting Federation. Measurements were taken ten days before the competition, representing about 10% of all participants in the Youth National Championships in the years studied (2020 and 2022). Somatic measurements included height, weight and body composition. Physical fitness tests comprised the squat jump for explosive lower-body power,

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the isometric mid-thigh pull-up test and handgrip for maximum strength measurement. Competition results were evaluated using the snatch [kg], clean and jerk [kg], and total [kg].

Results: The selection of variables for analysis was based on the strength of the correlational relationship between the variable and the sports results. Sex differences were observed in the height [cm] of the body, fat free mass index [kg/m^2], fat mass index [kg/m^2], handgrip [N], squat jump [W/kg], isometric mid-thigh pull [N]. Moreover, in all of the indicated variables, men obtained higher results.

Conclusions: The findings contribute to the understanding of sex-specific differences in somatic and physical fitness profiles among young weightlifters. This study highlights the importance of considering these differences in training and competition strategies for young athletes.

Keywords: strength, power, dimorphism

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Impact of the stance position during overcoming isometric conditioning activity on sprint and jumping performance in young soccer players

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Introduction: Complex training is defined as the combination of biomechanically similar high-load exercises with lighter-load power exercises, alternating set for set (e.g., back squats followed by countermovement jumps (CMJ)). The heavy resistance stimulus increases motoneuron excitability, possibly creating optimal training conditions for subsequent explosive exercises through post-activation performance enhancement (PAPE). PAPE refers to an acute improvement in voluntary performance often achieved by maximum voluntary contractions as a conditioning activity (CA). Isometric contractions can effectively develop joint-specific forces, making them suitable as a CA to enhance acceleration ability in soccer. To the best of the author's knowledge, there has been no study comparing the acute impact of bilateral and unilateral isometric CA on sprinting and jumping ability in young soccer players. The aim of the study was to evaluate the acute impact of maximal bilateral and unilateral isometric contraction as CA on 30-m sprint time and CMJ height in a group of U15 soccer players.

Materials and methods: The study involved 25 male U15 academy soccer players (age: 14 years, body mass: 62.9 ± 11 kg, body height: 172.5 ± 9.2 cm) divided into three groups: i) bilateral isometric (parallel stance), ii) unilateral isometric (split stance), iii) control (no CA). As CA, participants performed maximal pushing against the wall with different stance

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positions. Every group performed three sets of 3-s maximal isometric contraction. CMJ performance and 30-m sprint time were evaluated 4 min after every bout of isometric muscle action.

Results: The two-way repeated measures ANOVA (3 x 4) did not show statistically significant interactions in 5-m and 30-m sprint time, but showed significant interactions in time ($p < 0.001$; $\eta^2 = 0.035$) for CMJ height. Pairwise comparison for the interaction effect revealed that jump height was significantly lower in the 1st, the 2nd and the 3rd set compared to baseline ($p_{\text{bonf}} = 0.03, 0.002, <0.001$; Cohen's d : 0.332, 0.431, 0.479; respectively) with no difference between groups.

Conclusions: These results suggest that fatigue induced by overcoming isometric contraction may be too pronounced for young male athletes, as indicated by the decrease in CMJ height despite the lack of differences in sprint time.

Keywords: conditioning activity, power, speed

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Acute impact of blood flow restriction on strength-endurance performance in physically active women

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Introduction: One of the training methods used during resistance exercise is blood flow restriction (BFR). This involves applying external pressure via a cuff to the most proximal area of the upper and/or lower limbs. Previous studies using BFR in low-intensity training indicate that it reduces the number of repetitions performed until voluntary failure, but there are no such studies with high intensity and different tempos on multi-joint exercises. The main goal of the present study was to assess the effect of BFR on the maximum number of repetitions, time under tension, mean velocity and stiffness of the lateral head of the triceps brachii muscle in the bench press exercise (BP) with different movement tempos.

Materials and methods: The study included 12 physically active women (age: 22.5 ± 2 years; body mass: 64.1 ± 7.5 kg; bench press 1 repetition maximum (1RM): 46.7 ± 8.2 kg; resistance training experience: 2.5 ± 1.5 years). During the experimental sessions in a randomized crossover design, subjects performed five sets of the bench press exercise at 70% 1RM until voluntary failure under four different conditions: 2/0/X/0 fast tempo with or without BFR; 6/0/X/0 slow tempo with or without BFR. The following variables were analyzed: the number of performed repetitions, time under tension, mean bar velocity, and stiffness of the lateral head of the triceps brachii muscle (via myotonometry).

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Results: The three-way repeated measures ANOVA showed a significant interaction and main effect of condition for the number of performed repetitions, TUT between sets and tempo ($p < 0.001$) and mean bar velocity between sets ($p < 0.001$). No other statistically significant interactions or main effects were found.

Conclusions: This study shows that blood flow restriction has no acute effect on strength-endurance performance during the bench press exercise in physically active women. The obtained results indicate increasing fatigue with each subsequent set, leading to fewer repetitions performed and, consequently, to a lower TUT regardless of the BFR condition.

Keywords: resistance training, BFR, high intensity

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Kinetic analysis of combat moves: assessing the links between body segments weight and punches, front kick and countermovement jump performance

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Introduction: While the influence of strength and body composition on combat techniques and jumps is widely acknowledged, the dynamics between the force exerted in punches and kicks, the efficiency of countermovement jumps, and the weight distribution across body segments remain underexplored. Therefore, this study investigated the relationships among the performance metrics of direct punches (DP), palm strikes (PS), elbow strikes (ES), and front kicks (FK), as well as countermovement jumps (CMJ), in correlation with the weight distribution in different body segments, including the arms, legs, and the trunk.

Materials and methods: Sixteen male military cadets (22.3 ± 1.8 years, 181.4 ± 7.0 cm, 83.0 ± 8.1 kg, all measurements reported as mean \pm SD) serving at the Military Department of the Charles University participated in this study. Each participant performed three DP, PS, ES, and CMJ, along with five FK, in randomized order. Performance was quantified using a force plate, which measured peak force (N) and impulse (N·s) for the punches and kicks, as well as height (cm), concentric peak velocity (m/s), and both peak and impact force (N) for the CMJ within the breaking phase. Additionally, dual-energy X-ray absorptiometry (DEXA) was employed to assess participants' body composition. Spearman's correlation coefficient was used for statistical analysis of the data.

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Results: The striking arm weight moderately correlated with DP impulse ($r = 0.53, p \leq 0.05$) and ES impulse ($r = 0.54, p \leq 0.05$). Additionally, FK peak force and impulse demonstrated strong correlations with CMJ height (FK peak force: $r = 0.66, p \leq 0.01$; FK impulse: $r = 0.54, p \leq 0.05$), with FK peak force also showing a significant correlation with CMJ concentric peak velocity ($r = 0.54, p \leq 0.01$). Furthermore, the weights of the right and left legs were strongly correlated with CMJ impact force (right leg: $r = 0.80, p \leq 0.01$; left leg: $r = 0.77, p \leq 0.01$).

Conclusions: The study demonstrates correlations between body segment weight and performance in specific combat moves. The positive correlations between the weight of the striking arm and the impulse in direct punches and elbow strikes may suggest that targeted arm strength training could enhance these striking capabilities. Additionally, the significant relationship between kick force and jump height may indicate that improvements in leg strength and power can directly enhance both kicking performance and vertical jump ability, which are essential in combat scenarios. These insights are particularly relevant for military training programs, where optimizing each aspect of physical performance is vital. The study highlights the need for a more nuanced approach to strength training and testing in military contexts, one that considers the specific correlations between body segment weight and performance in various combat techniques.

Keywords: martial arts, punch and kick dynamics, biomechanics, jump, military

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Relationships between countermovement jump and change of direction performance in badminton players

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Introduction: Change of direction (COD) illustrates the athlete's ability to rapidly accelerate, decelerate and reaccelerate in different directions. COD occurs frequently throughout a badminton match and includes jumps, lunges and rapid COD, particularly the high frequency of stop-and-go maneuvers. To the best of the author's knowledge, no study has investigated the relationship between COD performance and the height and peak velocity of the countermovement jump (CMJ). Therefore, our aim was to investigate the relationship among CMJ height, peak velocity and COD performance.

Materials and methods: Eleven young badminton players participated in the study, comprising seven males (age: 15 ± 3 years, body mass = 62.1 ± 15 kg, body height = 176.3 ± 8.3 cm) and four females (age = 15 ± 2 years, body mass: 54.2 ± 5.7 kg, body height = 160.2 ± 7.2 cm). All participants were right-legged. To investigate the relationship among CMJ height, peak velocity and COD performance, participants completed CMJ and 10-m COD tests with turns on the dominant limb at different COD angles (COD-45°, COD-90°, COD-135°, COD-180°).

Results: Spearman rank order revealed a significant negative large to very large relationship between CMJ peak velocity and each COD angle examined (COD-180° = -0.661 ; COD-135°

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= -0.654 ; $COD-90^\circ = -0.8$; $COD-45^\circ = -0.589$; $p < 0.05$ for all). In addition, only between CMJ height and $COD-45^\circ$ (-0.674) a significant negative large correlation was found.

Conclusions: Findings from this study reveal that examined CMJ variables are associated with COD performance, while peak velocity seems to be more related than jump height to various COD change angles.

Keywords: jump height, agility, correlations

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A comparison of a step load unilateral and bilateral resistance training program on the strength and power of the lower limbs in soccer players

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Introduction: The purpose of the investigation was to determine the influence of a four-week unilateral (UNI) and bilateral (BIL) resistance training program on peak torque and peak power of the lower limbs in soccer players. We evaluated the effects of a 3:1 step load training program using UNI and BIL forms of exercises on the level of peak torque and peak power of the knee joint extensors and flexors.

Materials and methods: The study included 16 division I soccer players having the highest number of matches played in the first round of the season. The motor tests included isokinetic evaluation of peak torque and peak power of the extensors and flexors of the knee joint.

Results: The results showed that both types of training sessions were equally effective. Only in terms of power during knee flexion, unilateral training contributed to improvement, whereas bilateral training did not.

Conclusions: The use of periodization using a step load progression based on an extended eccentric phase of the movement during the preseason period in combination with UNI training may increase peak torque and peak power of knee flexors and extensors in soccer players.

Keywords: periodization, injury prevention, peak torque, stability

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The effect of physical activity and relaxation techniques on the symptoms of irritable bowel syndrome

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Poland

Introduction: Rapid urbanization and constant technological progress contribute to a change in the lifestyle in terms of physical activity. Lack of free time and reluctance to engage in physical activity may lead to impaired functioning of internal organs and systems, including the digestive system. In the present study, by creating an exercise regimen requiring systematic use, an attempt was made to demonstrate the impact of this activity on the symptoms of patients with irritable bowel syndrome.

Materials and methods: Forty-one women with diagnosed irritable bowel syndrome were qualified for the study. To assess the effectiveness of the method used, the validated IBS-SSS (irritable bowel syndrome-severity scoring system) questionnaire was used. The study used an original training program based on the basic steps used in a fitness lesson, yoga positions improving intestinal motility and relaxation training: autogenic by Schultz and Jacobson. Twenty-nine women completed the entire two-month training cycle, in line with the assumptions of the study. The analysis of the obtained results was made using the Statistica program. The following methods were used: *t*-test for dependent samples, Wilcoxon pairwise order test, Mc Nemar's chi² test and Sperman's R correlation coefficient.

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Results: It was shown that nearly 80% of the study participants experienced abdominal pain before participating in the study. The training cycle caused pain in 52% of the surveyed women. The intensity of pain in the subjects decreased by 20%. After the study, the incidence of flatulence decreased by 38% and the severity of flatulence by 30%.

Conclusions: The relationship between physical activity and the severity of symptoms of irritable bowel syndrome in the surveyed women was confirmed. The study group of women showed a reduction in IBS-related symptoms after 8 weeks of training.

Key words: irritable bowel syndrome, pain, flatulence, physical activity

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Should we avoid daily caffeine intake to benefit from its pre-workout use? The impact of acute caffeine intake on maximal strength, strength-endurance, and jumping performance in habitual caffeine users

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Introduction: Caffeine is the most commonly used psychoactive and ergogenic substance among athletes. Although previous studies confirmed the positive effect of acute caffeine intake on sports performance, it is not clear whether habitual caffeine consumption impacts the magnitude of its ergogenic effect. The aim of this study was to examine the impact of acute caffeine intake on maximal strength, strength-endurance, and jumping performance in habitual caffeine users.

Materials and methods: Eight strength-trained habitual caffeine users (daily caffeine ingestion: 4.90 ± 2.38 mg/kg/day; range 1.07–8.49 mg/kg/day) participated in the study with a randomized double-blind experimental design, after intake of placebo or 3 mg/kg of caffeine. In each experimental session, participants performed a one repetition maximum (1RM) test, a strength-endurance test at 50%1RM in the bench press exercise and a countermovement jump.

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Results: There was no significant correlation between the level of habitual caffeine intake and performance changes in the 1RM test, the strength-endurance test and the countermovement jump ($p = 0.129$, $p = 0.840$, and $p = 0.910$, respectively).

Conclusions: This study suggests that habitual caffeine consumption does not affect the magnitude of ergogenic effect of acute caffeine intake, at least in resistance-trained individuals.

Keywords: ergogenic substances, strength training, habitual consumption

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Effects of Eccentric Speed during Front Squat Conditioning Activity on Post-activation Performance Enhancement of Hip and Thigh Muscles

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Abstract

The phenomenon of post-activation performance enhancement plays an unidentified role in movement eccentric speed and individual muscle group responses. Therefore, this study aimed to determine whether the loaded front squat (FSq) speed of the eccentric phase would influence the post-activation performance enhancement effect and whether the FSq would elicit similar performance enhancement of knee flexion, knee extension, hip flexion, and hip extension muscles. Twenty resistance-trained handball players performed the FSq under maximum eccentric-concentric speed and 2-s eccentric speed (only the eccentric phase performed), while pre- and post-front squat countermovement jump, knee, and hip isokinetic flexion/extension performance were tested. The FSq conditioning activity was performed in a single set of three repetitions with either 90% (maximum eccentric-concentric speed) or 120% (2-s eccentric speed) of one repetition maximum, and post-performance was measured 4–12 min after the FSq. Athletes randomly changed the FSq eccentric speed and tested the hip or knee isokinetic flexion/extension strength at 180°/s. ANOVA showed that the rate of force

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development during the jump increased (Cohen's $d = 59-77$) with no differences between 2-s eccentric and maximum speed eccentric protocols. Isokinetic strength increased after the 2-s eccentric FSq in hip extension ($d = 0.76-0.86$), knee flexion ($d = 0.74-0.88$), and hip flexion ($d = 0.82$), with no differences in knee extension strength. After maximum eccentric-concentric speed, isokinetic strength increased in hip extension ($d = 1.25$). In conclusion, the FSq conditioning activity enhances hip extensors' performance more than knee extensors' performance. Different eccentric types of muscle action during a conditioning activity alter the level of local muscle enhancement.

Keywords: post-activation potentiation; complex training; power training; isokinetic; handball

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Strength Training Frequency and Athletic Performance in High School Girls Basketball Players

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Abstract

This study investigated the effects of a six-week strength training intervention on the physical fitness of female high school athletes, with a focus on training frequency. Twenty-three female high school basketball athletes were recruited and split into two groups: one group participated in strength training once per week (S1), while the other participated in two training sessions per week (S2). The groups were not random as training sessions were voluntary, and some participants were only able to train once per week. Participants were tested before and after the intervention, and the data included: age, body height, body mass, body fat percentage, grip strength, leg/back dynamometer (LBD) strength, a seated medicine ball throw (MBT), a vertical jump (VJ), 505 tests from each foot, 0–5, 0–10, and 0–20 sprint times, and multistage fitness test shuttles. Data were analyzed by a two (time) x two (group) repeated measures analysis of variance (ANOVA; $p < 0.05$). When significant F ratios were detected in any ANOVA calculations, post hoc pairwise comparisons were conducted using the Bonferroni adjustment procedure. There were significant main effects for time that indicated the following:

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increased body height, body mass, grip strength, LBD strength, MBT distance, and VJ height, faster 505 times, and slower 0–5 and 0–10 m sprint times ($p \leq 0.021$). There were no significant time by group ANOVAs or between-group main effects. These performance changes occurred irrespective of training frequency. High school girls who participate in at least one strength training session per week can improve their strength (grip, LBD), power (MBT, VJ), and change-of-direction speed (505).

Keywords: adolescents; change-of-direction speed; female athletes; power; resistance training

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Do Activities Performed within the Intra-Contrast Rest Interval Affect Neuromuscular Performance during Complex-Contrast Training Protocols?

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Abstract

The aim of this study was to analyze the acute effects of including different exercises within the intra-contrast rest interval (ICRI) of a complex-contrast training (CCT) session. Seventeen recreationally active males completed three different CCT protocols. Programs consisted of a contrast pair combining a moderate-intensity conditioning activity (i.e., a back squat) with a lower-body high-velocity exercise (i.e., a vertical jump) and only differed in the activities performed during the ICRI: 1) passive recovery (CCT_{PASS}); 2) a mobility exercise (CCT_{MOB}); and 3) an upper-body high-intensity strength exercise (i.e., a bench press) (CCT_{STR}). Countermovement jump and bench press throw metrics were evaluated at baseline and after each set during the workout. The rate of perceived exertion was recorded post-session. Non-significant differences in performance were found between CCT_{PASS}, CCT_{MOB} and CCT_{STR}

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throughout the session. Significant declines ($p < 0.05$) were observed for CMJ peak power in the last 2–3 repetitions of each set, irrespective of the protocol. CCT_{STR} was perceived as more intense than CCT_{PASS} and CCT_{MOB} ($p < 0.05$). From a neuromuscular performance perspective, including activities during the ICRI (mobility drills or high-intensity strength exercises) may be a suitable strategy to optimize CCT prescription since the acute responses were similar to those found with passive rest periods. Finally, prescribing a lower number of repetitions per set is recommended to attenuate mechanical performance impairment during CCT protocols, irrespective of the activities completed within the ICRI.

Keywords: postactivation performance enhancement; kinetic analysis; athletic performance; neuromuscular; mechanical power; range of motion

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High-Density Electromyography Excitation in Front vs. Back Lat Pull-Down Prime Movers

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Abstract

The current study compared the spatial excitation of the primary muscles during the lat pull-down exercise with the bar passing in front (front-LPD) or behind the neck (back-LPD) using high-density electromyography. Fourteen resistance trained men performed a front-LPD or a back-LPD within a non-fatiguing set with 8-RM as the external load. The muscle excitation centroid of latissimus dorsi, middle trapezius, pectoralis major, biceps brachii, triceps brachii and posterior deltoid muscles were recorded during the ascending and the descending phase. During the descending phase, the front-LPD showed superior excitation of the latissimus dorsi (ES = 0.97) and the pectoralis major (ES = 1.17), while in the ascending phase, the back-LPD exhibited superior excitation of the latissimus dorsi (ES = 0.63), and the front-LPD showed superior excitation of the biceps brachii (ES = 0.41) and the posterior deltoid (ES = 1.77). During the descending phase, the front-LPD showed a more lateral centroid of the latissimus dorsi (ES = 0.60), the biceps brachii (ES = 0.63) and the triceps brachii (ES = 0.98), while the centroid was more medial for the middle trapezius (ES = 0.58). The centroid of the middle

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trapezius was also more medial in the front-LPD during the ascending phase (ES = 0.85). The pectoralis major centroid was more cranial in the front-LPD for both the descending (ES = 1.58) and the ascending phase (ES = 0.88). The front-LPD appears to provide overall greater excitation in the prime movers. However, distinct spatial excitation patterns were observed, making exercise suitable for the training routine.

Keywords: resistance training; strength training; muscle; eccentric

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Fatigue and Metabolic Responses during Repeated Sets of Bench Press Exercise to Exhaustion at Different Ranges of Motion

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Abstract

This study compared the acute effects of different ranges of motion (ROM) on fatigue and metabolic responses during repeated sets of bench press exercise. Ten resistance trained men performed three sets to momentary failure with two-min rest intervals at three different ROM: full ROM (FULL), and partial ROM in which the barbell was moved either at the bottom half (BOTTOM) or the top half (TOP) of the full barbell vertical displacement. In TOP, a higher load was lifted, and a higher total number of repetitions was performed compared to FULL and BOTTOM (130 ± 17.6 vs. 102.5 ± 15.9 vs. 98.8 ± 17.5 kg; 55.2 ± 9.8 , 32.2 ± 6.5 vs. 49.1 ± 16.5 kg, respectively $p < 0.01$). Work per repetition was higher in FULL than TOP and BOTTOM (283 ± 43 vs. 205 ± 32 vs. 164 ± 31 J/repetition, $p < 0.01$). Mean barbell velocity at the start of set 1 was 21.7% and 12.8% higher in FULL compared to TOP and BOTTOM, respectively. The rate of decline in mean barbell velocity was doubled from set

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1 to set 3 ($p < 0.01$) and was higher in FULL than both TOP and BOTTOM ($p < 0.001$). Also, the rate of mean barbell velocity decline was higher in BOTTOM compared to TOP ($p = 0.045$). Blood lactate concentration was similarly increased in all ROM ($p < 0.001$). Training at TOP ROM allowed not only to lift a higher load, but also to perform more repetitions with a lower rate of decline in mean barbell velocity. Despite the lower absolute load and work per repetition, fatigue was higher in BOTTOM than TOP and this may be attributed to differences in muscle length.

Keywords: velocity-based training; blood lactate; muscle length

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The Effects of Holistic, External, and Internal Attentional Focus Instructions on Power and Kinematics of the Hang Power Snatch in Highly Skilled Weightlifters

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Abstract

Athletes across various sports seek to enhance their power generation and force production by incorporating weightlifting exercises into their training. Therefore, integrating partial weightlifting movements could be sensible due to their simplified execution. Our research aimed to investigate which of four attentional focus strategies (external, internal, holistic, and neutral) would have the greatest impact on performance in terms of power variables for highly experienced weightlifting athletes in a practical training setting. Twelve highly skilled Olympic weightlifters volunteered for the study. They performed 48 single repetitions of the hang power snatch with each of the four attentional focus strategies. Results of the ANOVA did not reveal a significant main effect for maximum velocity, power measurement and displacement. Despite extensive research demonstrating how attentional

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focus affects performance differently, even among highly skilled populations, the lack of observed effects in our study underscores the challenges of conducting research in applied settings.

Keywords: training; motor performance; barbell kinematics; Olympic lifts

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The Effect of Time-Equated Concurrent Training Programs in Resistance-Trained Men

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Abstract

The purpose of this investigation was to compare the effects of three different concurrent training (CT) programs and a resistance training (RT) program. Twenty-three resistance trained men (age: 24 ± 3 years) were randomized into four groups: concurrent RT and high intensity interval cycling (CTH, $n = 6$), concurrent RT and moderate intensity continuous cycling (CTM, $n = 5$), RT and barbell circuit training (RTC, $n = 6$), or RT only (RT, $n = 6$). Back squat and bench press strength, quadriceps, and pectoralis muscle thickness, VO_{2peak} , and maximum workload (W_{max} , Watts) were assessed. Squat strength gains were meaningful in all groups and comparable among CTH (16.88 kg [95% CrI: 11.15, 22.63]), CTM (25.54 kg [95% CrI: 19.24, 31.96]), RTC (17.5 kg [95% CrI: 11.66, 23.39]), and RT (20.36 kg [95% CrI: 15.29, 25.33]) groups. Bench press strength gains were meaningful in all groups and comparable among CTH (11.86 kg [95% CrI: 8.28, 15.47]), CTM (10.3 kg [95% CrI: 6.49,

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14.13]), RTC (4.84 kg [95% CrI: 1.31, 8.47]), and RT (10.16 kg [95% CrI: 7.02, 13.22]) groups. Quadriceps hypertrophy was meaningful in all groups and comparable among CTH (2.29 mm [95% CrI: 0.84, 3.76]), CTM (3.41 mm [95% CrI: 1.88, 4.91]), RTC (2.6 mm [95% CrI: 1.17, 4.05]), and RT (2.83 mm [95% CrI: 1.55, 4.12]) groups. Pectoralis hypertrophy was meaningful in CTH (2.29 mm [95% CrI: -0.52, 5.1]), CTM (5.14 mm [95% CrI: 2.1, 8.15]), and RTC (7.19 mm [95% CrI: 4.26, 10.02]) groups, but not in the RT group (1 mm [95% CrI: -1.59, 3.59]); further, between-group contrasts indicated less pectoralis growth in the RT compared to the RTC group. Regarding cardiovascular outcomes, only the RTH and RTM groups experienced meaningful improvements in either measure (VO_{2peak} or W_{max}). These data suggest that the interference effect on maximal strength and hypertrophy can be avoided when the aerobic training is moderate intensity cycling, high intensity cycling, or a novel barbell circuit for ~one hour per week and on non-RT days. However, the barbell circuit failed to elicit meaningful cardiovascular adaptations.

Keywords: resistance exercise; aerobic training; strength; hypertrophy

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Are Diminishing Potentiation and Large Extensor Moments the Cause for the Occurrence of the Sticking Region in Maximum Free-Weight Barbell Back Squats among Resistance-Trained Males?

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Abstract

This study compared the kinematics, surface electromyography (sEMG) and kinetics among isometric squats performed at 10 different heights of the upward part and a one-repetition maximum (1-RM) squat. Eleven males (age: 27.5 ± 3.4 years, body mass: 84.9 ± 8.1 kg, body height: 1.79 ± 0.06 m, 1-RM squat: 152.2 ± 20.55 kg) took part in this study. It was found that force output was lowest in the sticking region at around the event of peak deceleration for the 1-RM trial with force output at 2179 ± 212 N. For the isometric trial, the lowest force output occurred at the lowest barbell height (1735 ± 299 N). In addition, for the 1-RM condition hip extension moments peaked at the first four barbell heights (6.5–6.2 Nm/kg) representing the pre-sticking and the sticking region before significantly decreasing during the events representing the post-sticking region. Additionally, the sEMG amplitude peaked for the hip extensors at the barbell heights corresponding to the post-sticking region. Moreover, the sEMG amplitude was significantly higher for the 1-RM condition for all hip extensors, vastus lateralis, and calf muscles ($F \geq 2.7$, $p \leq 0.01$, $\eta_p^2 \geq 0.25$). Therefore, we suggest that the sticking region

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occurs because of reduced force output in the pre-sticking and the sticking region in back squats among resistance-trained males. The reduced force output is probably a combination of suboptimal internal moment arms, length-tension relationships of the gluteus maximus, hamstring and vastii muscles in the pre-sticking and sticking regions to overcome the large extensor moments together with diminishing potentiation from the pre-sticking to the sticking region.

Keywords: resistance exercise; sticking point; strength; kinetics; kinematics

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Braking and Propulsion Phase Characteristics of Traditional and Accentuated Eccentric Loaded Back Squats

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Abstract

The purpose of this study was to examine the differences in braking and propulsion force-time characteristics and barbell velocity between traditional (TRAD) and accentuated eccentric loaded (AEL) back squats using various load combinations. Sixteen resistance-trained men participated in four separate testing sessions which included a one repetition maximum (1RM) back squat during the first session and three squat testing sessions. During the squat testing sessions, participants either performed sets of three repetitions of TRAD back squats each with 50, 60, 70, and 80% 1RM or performed the same loads with the addition of weight releasers that increased the total eccentric weight of the first repetition of each set to either 100 (AEL-MAX) or 110% 1RM (AEL-SUPRA). Braking and propulsion mean force, duration, and impulse as well as mean and peak barbell velocity were compared between each condition and

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load. Significantly greater braking impulses were produced during the AEL-MAX and AEL-SUPRA conditions compared to TRAD ($p < 0.03$) with small-moderate effect sizes favoring AEL-SUPRA. No other significant differences existed among conditions for other braking, propulsion, or barbell velocity variables. AEL-MAX and AEL-SUPRA back squats may provide a greater braking stimulus compared to TRAD squats; however, the propulsion phase of the movement does not appear to be impacted. From a loading standpoint, larger and smaller load spreads may favor rapid and maximal force production characteristics, respectively. Further research on this topic is needed as a large portion of the braking stimulus experienced during AEL back squats may be influenced by relative strength.

Keywords: strength; rate of force development; impulse; velocity-based training; power

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Changes of Anaerobic Power and Lactate Concentration Following Intense Glycolytic Efforts in Elite and Sub-Elite 400-meter Sprinters

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Abstract

400-m races are based on anaerobic energy metabolism, they induce significant muscle fatigue, muscle fiber damage, and high blood lactate (LA) concentration. Despite extensive research on sprint training, our understanding of the training process that leads to world-class sprint performance is rather limited. This study aimed to determine differences in LA concentration and anaerobic power using jumping tests after an intense glycolytic effort in a group of elite and sub-elite 400-m runners. One hundred thirty male runners were divided into two groups: elite ($n = 66$, body mass = 73.4 ± 7.8 kg, body height = 182.1 ± 6.2 cm, age = 20.8 ± 4.0 y) running the 400-m dash below 50 s and sub-elite ($n = 64$, body mass = 72.0 ± 7.1 kg, body height = 182.1 ± 5.2 cm, age = 20.8 ± 4.0 y) with a 400-m personal best above 50 s. The power of the countermovement and the sequential squat jumps was measured in two sets after a warm-up, followed by two intermittent 30-s Wingate tests. LA concentration was measured

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eight times. It was observed that elite athletes achieved significantly higher power in both types of jumps. The maximum post-exercise LA concentration was significantly lower in the sub-elite group after the 3rd, the 6th, the 9th, and the 20th min after the cessation of two Wingate tests ($p < 0.001$). The rate of LA accumulation after exercise and the rate of LA utilization did not differ between the groups. It can be concluded that elite and non-elite runners differ in higher LA production, but not in LA utilization. Anaerobic power and LA concentration seem to differentiate between 400 elite and sub-elite performance.

Keywords: fatigue; competition; blood lactate; sprinting

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The Effects of Resistance Training on Sport-Specific Performance of Elite Athletes: A Systematic Review with Meta-Analysis

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Abstract

This systematic review examines the influence of resistance training (RT) on the performance outcomes of elite athletes. Adhering to PRISMA guidelines, a comprehensive search across PubMed, Scopus, SPORTDiscus, and Web of Science databases was conducted, considering studies up to November 19, 2023. The inclusion criteria were elite athletes involved in high-level competitions. Studies were categorized by the competitive level among elite athletes, athlete's sex, performance outcomes, and a training modality with subgroup analyses based on these factors. Thirty-five studies involving 777 elite athletes were included. The results of the meta-analysis revealed a large and significant overall effect of RT on sport-specific performance (standardized mean difference, SMD = 1.16, 95% CI: 0.65, 1.66), with substantial heterogeneity ($I^2 = 84\%$). Subgroup analyses revealed differential effects based on the competitive level, the type of sport-specific outcomes, and sex. National elite athletes showed more pronounced (large SMD) benefits from RT compared to international elite

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athletes (small SMD). Global outcomes revealed a medium but non-significant ($p > 0.05$) SMD, while local outcomes showed a large SMD. Notably, female athletes exhibited a large SMD, though not reaching statistical significance ($p > 0.05$), probably due to limited study participants. No significant ($p > 0.05$) differences were found between heavy and light load RT. Resistance training is effective in improving sport-specific performance in elite athletes, with its effectiveness modulated by the competitive level, the type of the performance outcome, and athlete's sex. The findings underscore the need for personalized RT regimens and further research, particularly in female elite athletes, as well as advanced RT methods for international elite athletes.

Keywords: weight training; strength exercise; strength and conditioning; plyometrics; sport-specific outcomes

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A Practical Approach for Ischemic Preconditioning Intervention in Sports: A Pilot Study for Cuff Thigh Occlusion Pressure Estimation Based on Systolic Blood Pressure

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Abstract

For the ischemic preconditioning (IPC) intervention, the accuracy of the protocol is paramount for mediating its possible ergogenic effects. However, the lack of standardization and widespread use of arbitrary cuff pressures (ranging from 130 to >300 mmHg) have been predominantly observed, potentially affecting the results and compromising the reproducibility of findings. Thus, the purpose of this study was to determine an appropriate cuff pressure during IPC. Seventeen healthy male participants were enrolled in the study. Anthropometric measurements were initially conducted, followed by systolic and diastolic blood pressure measurements. Subsequently, we determined the individual thigh occlusion pressure (TOP) for the right leg using a hand-held Doppler device. Based on these findings, we developed an estimation equation for TOP, considering the current brachial systolic blood pressure (SBP) values. We then conducted a retrospective analysis of its capacity to mediate occlusion. We observed the ability to estimate TOP using the equation ($p = 0.01$; ES: 0.86), presenting ~6%

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superiority in absolute values for occlusion compared to direct measurement (TOP equation: 169.9 ± 9.1 ; TOP direct measured: 161.2 ± 11.1). However, TOP estimation was insufficient to produce complete occlusion in two out of 17 subjects (11.8%). In conclusion, the estimation of TOP incorporating SBP values may offer a valid and practical means for cuff administration during IPC protocols with potential to minimize adverse effects and maximize its positive effects.

Keywords: ischemia; reperfusion; arterial pressure; tourniquet

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The Importance of Recovery in Resistance Training Microcycle Construction

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Abstract

Systemic resistance training aims to enhance performance by balancing stress, fatigue and recovery. While fatigue is expected, insufficient recovery may temporarily impair performance. The aim of this review was to examine evidence regarding manipulation of resistance training variables on subsequent effects on recovery and performance. PubMed, Medline, SPORTDiscus, Scopus and CINAHL were searched. Only studies that investigated recovery between resistance training sessions were selected, with a total of 24 articles included for review. Training to failure may lengthen recovery times, potentially impairing performance; however, may be suitable if implemented strategically ensuring adequate recovery between sessions of similar exercises or muscle groups. Higher volumes may increase recovery demands, especially when paired with failure training; however, with wide variation in individual responses, it is suggested to start with lower volume, monitor recovery, and gradually increase if appropriate. Exercises emphasising the lower body, multi-joint movements, greater muscle recruitment, eccentric contractions, and/or the lengthened position may require longer recovery times. Adjusting volume and frequency of these exercises can affect recovery

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demands depending on the goals and training logistics. Daily undulating programming may be may maximise performance on priority sessions while maintaining purposeful and productive easy days. For example, active recovery in the form of training opposing muscle groups, light aerobic cardio, or low-volume power-type training may improve recovery and potentially elicit a post activation potentiation priming effect compared to passive recovery. However, it is possible that training cessation may be adequate for allowing sufficient recovery prior to sessions of importance.

Keywords: fatigue; strength; hypertrophy; monitoring

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The Impact of Range of Motion on Applied Force Characteristics and Electromyographic Activity during Repeated Sets of Bench Press Exercise

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Abstract

This study examined the effects of range of motion (ROM) on applied force, power output and electromyographic (sEMG) responses during repeated sets of bench press exercise executed as fast as possible. Ten resistance trained men performed three sets to momentary failure with two-min rest intervals under three different ROM conditions: (a) full ROM (FULL), (b) TOP, at the top half of ROM, and (c) BOTTOM, at the bottom half of ROM. Mean and peak force were higher in TOP compared to FULL and BOTTOM (mean force: 817 ± 80 vs. 657 ± 98 vs. 623 ± 122 N, respectively, $p < 0.001$) with no differences between FULL and BOTTOM. During repeated sets, large decreases were found in peak (by 29.4 to 45.3%) and mean power (by 55.5 to 64.7%) from the first to the last repetitions. However, the decrease in mean force was only 2% ($p < 0.01$) and decreases in peak force ranged from 6.7 and 8.8% to zero, indicating the velocity loss was the main contributor to fatigue in power output. Although force and power output in set 3 were unchanged in BOTTOM, mean power output decreased significantly, suggesting that lower performance and fatigue may be related to the longer muscle length.

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Fatigue was accompanied by an increase in sEMG activity and a decrease in median frequency in all muscles, with triceps brachialis sEMG reflecting more force and power differences among ROMs. In conclusion, fatigue depends on velocity rather than force loss during bench press exercise at different ROMs.

Keywords: fatigue; EMG; resistance exercise; impulse; force plate

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Not only Protein: Dietary Supplements to Optimize the Skeletal Muscle Growth Response to Resistance Training

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Abstract

Regarding skeletal muscle hypertrophy, resistance training and nutrition, the more often discussed and proposed supplement are proteins. Although, the correct amount, quality, and daily distribution of proteins is of paramount importance for skeletal muscle hypertrophy, there are many other nutritional supplements that can help and support the physiological response of skeletal muscle to resistance training in terms of muscle hypertrophy. A healthy muscle environment and a correct whole muscle metabolism response to stress induced by training is a prerequisite for the increase of muscle protein synthesis and, therefore, of muscle hypertrophy. In this review, we discuss the role of different nutritional supplements such as carbohydrates, vitamins, minerals, creatine, omega-3, polyphenols, and probiotics as a support and complementary factors to the main supplement i.e., proteins. The different mechanisms are discussed in the light of recent evidence.

Keywords: sport nutrition; supplementation; skeletal muscle hypertrophy

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Jump Squats Performed with Both Light and Heavy Loads Have Similar Effects on the Physical Performance of Elite Rugby Players during the Initial Phase of the Competitive Period

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Abstract

We examined the effectiveness of two different jump-squat (JS) loading ranges on the physical performance of rugby players. Twenty-eight elite male rugby players were divided into two JS training groups: a light-load JS group (“LJS”; JS at 40% of the one-repetition maximum [1RM] in the half-squat [HS] exercise) or a heavy-load JS group (“HJS”; JS at 80% HS-1RM). Players completed the distinct training programs over four weeks, three times per week, during the initial phase of the competitive period. Pre- and post-training tests were

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conducted in the following sequence: vertical jumps, 30-m speed, peak-power in the JS and HS, and maximum isometric force in HS. Additionally, the rating of perceived exertion (RPE) was assessed at the end of all training sessions throughout the intervention. A two-way ANOVA with repeated measures, followed by Tukey's post-hoc, was employed to analyze differences between groups. The statistical significance level was set at $p < 0.05$. Effect sizes were used to assess the magnitude of differences between pre- and post-training data. Except for the RPE values (which were lower in the LJS group), no significant changes were detected for any other variable. In summary, using either a light- (40 %HS-1RM) or a heavy-load (80 %HS-1RM) JS during the initial phase of the competitive period is equally effective in maintaining the physical performance levels attained during the preceding training period (pre-season), with the significant advantage of resulting in lower levels of the RPE. This finding may have important implications for resistance training programming, especially in disciplines where acute and chronic fatigue are always problematic issues.

Keywords: team-sports; sprint velocity; muscle power; athletic performance; resistance training

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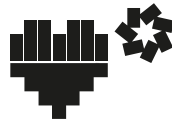


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