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Evaluation of the Effect of Intensive Resistance Exercises on Anaerobic and Balance Performance in Young Football Players

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Abbreviations used in the Thesis

6 PPO	six-second peak power output
AAPS	Average anterior-posterior sway speed
AMLS	Average medial-lateral sway speed
APD	Anterior-posterior direction
CG	Control groups
CMJ	Countermovement jump
CP	Cadence peak
COD	Change of direction
CoP	Centre of pressure
DEF	Defenders
D	Dominant leg
DF	Dorsiflexion
EA	Ellipse area
F	Forwards
FI	Fatigue index
GK	Goalkeeper
HJ	Height jump
HR	Heart rate
IG	Intervention groups
MD	Midfielders
MF	Maximum force
MLD	Medial-lateral direction
MP	Mean power
MVIC	Maximal voluntary isometric contraction
ND	Non-dominant leg
NSCA	National Strength and Conditioning Association
P	Perimeter
PF	Plantar flexion
PPO	Peak power output
RE	Resistance training
ROM	Range of Motion
RPE	Rate of perceived exertion
RPM	Revolutions per minute
RTSC	Resistance training skill competency
SSC	Stretch-shortening cycle

SJ	Squat jump
TD	Trunk deviation
TF	Time of flight
TP	Time to peak
TSI	Total stability index
TTD	Total trunk deviation
WAnT	Wingate anaerobic test

Introduction

Football is a team sport that involves numerous actions over a 90-minute period, during which players undergo 1000 to 1400 unpredictable locomotor activity changes every 3 to 6 seconds (Castellano et al., 2011). Physical performance is one aspect of predicting team success, as a study by Redkva et al. (2018) proved that less fit players tend to perform fewer high-intensity actions throughout a match. During football matches, low-intensity movements comprised 70 to 84.1 %, moderate 8.3 %, while high-intensity 7.6 % of the total game (Bangsbo et al., 2006; Hoff, 2005; Hulton et al., 2008; Njororai, 2012). However, based on blood lactate (LA), heart rate (HR), and Rate of Perceived Exertion (RPE) responses, young elite football players experienced greater physiological stress during the first half of matches than in the second half (Aslan et al., 2012), but similar physiological stress during match play according to playing position (Aslan et al., 2012).

In addition to the high aerobic demands of football, analyses reveal that players sprint between 1 % and 11 % of the total game time. Each sprint lasts 2 to 4 seconds, with repetitions occurring every 60 to 90 seconds, resulting in approximately 60 to 90 sprints per match (Shalfawi, 2015). These sprints indicate a high energy demand on the anaerobic system and require repeated high-velocity sprints throughout the game. Anaerobic process becomes important when players perform intense actions (e. g. sprinting and shooting), transition between activities (e. g. backwards running followed by a header), and during shifts to higher intensities (e. g. jogging to high-speed running) (Hostrup & Bangsbo, 2022; Nilsson & Cardinale, 2015). Brief intense actions occur over 250 times during a game that relies on the anaerobic energy system (Bangsbo et al., 2006). These actions are crucial to a game's final performance and results. Nikolaidis et al. (2018) in their study reported that the main effect of age on anaerobic test results (WAnT, 20m sprint, SJ, and CMJ) was observed among male football players, with older age groups showing better performance. However, peak power ($p = 0.32$), mean power ($p = 0.54$), 20m ($p = 0.07$), SJ ($p = 0.65$), and CMJ ($p = 0.34$) were not significantly different in playing position.

In line with the previously mentioned, one fundamental neuromuscular attachment skill that may also contribute to successful football performance is balance (Paillard et al., 2006; Ricotti et al., 2013). The balance performance is related to the improvement of sport-specific skills, movement techniques in football, and injury prevention. The study by Mitrousis et al. (2023) revealed that improvements in static and dynamic balance after specific balance training enhance shooting accuracy with the dominant leg in young football players. Moreover, regular football training combined with balance training improved dynamic balance performance and reduced lower limb injuries by over 25 % (Gebel et al., 2018). Balance performance relies on the central processing of ankle proprioceptive sense acuity. It contributes to reducing the incidence of falls and sports injuries (Han et al., 2015). Balance supported by ankle mobility and explosive strength of the lower extremity muscles is the most important contributor to various movements, particularly change of direction (COD) (Guzman et al., 2022). Ankle dorsiflexion plays a role in absorbing and transferring force, while balance ability may enable faster COD performance at various angles from 45° to 180° (Rouissi et al., 2018). Moreover, precise ankle rotation was linked to balance proficiency (stability of the supporting limb) and accuracy of ankle movements during shooting or passing (Cameron & Adams, 2003; Cè et al., 2018).

Paediatric fitness programs should include various neuromuscular exercises to enhance motor skills and fitness, which are critical for football practice (Hammami et al., 2023). Resistance exercise (RE) is considered a key approach for improving football performance because of the link between strength levels and high-intensity actions (Nuñez et al., 2019; Swinton et al., 2014). RE is one of the prominent training methods to include in the regular training sessions of various sports due to its safety, effectiveness, and injury prevention (Faigenbaum & Myer, 2010; Lloyd et al., 2014). RE refers to a conditioning method that gradually incorporates a variety of resistive loads, different movement velocities, and various training modalities aimed at improving health, fitness, and sports performance (Faigenbaum et al., 2009). RE methods include body weight, free weights, weight machines, elastic bands, medicine balls, and manual resistance. However, the term RE should be distinguished from the sport of weightlifting, which involves performing the snatch and clean and jerk (Faigenbaum et al., 2019). The fundamental principles of RE for youth are known as PROCESS (Progression, Regularity, Overload, Creativity, Enjoyment, Socialization, and Supervision) (Faigenbaum et al., 2016).

Integrative neuromuscular training is a multimodal form of exercise that implements resistance exercises, dynamic stability, core exercises, and plyometric and agility training performed in short intervals with intermittent rest (Myer et al., 2011). In the clinical report, which was reaffirmed in November 2024 by the American Academy of Paediatrics (Stricker et al., 2020), the authors suggested that resistance exercise can begin with 1–2 sets of 8–12 repetitions at a low intensity, (i. e. 60 % 1 RM) as proper technique is developed. Afterward, the RE program can be progressed from 2–4 sets of 6–12 repetitions with a low to moderate intensity (≤ 80 % 1RM). Young athletes can be introduced to periodic phases of lower repetition ranges (< 6) at higher training intensity (> 80 % 1RM) provided that resistance training skill competency (RTSC) is high (Lesinski et al., 2016).

The integrative neuromuscular training including balance, strength, plyometric, and COD exercises, has been implemented to improve physical fitness in youth male soccer players (Hammami et al., 2023). Moreover, RE programs incorporating various training strategies and modalities have been shown to enhance overall physical fitness among young football players (Chaouachi et al., 2017; Hammami et al., 2016, 2023; Muehlbauer et al., 2019). However, RE protocols such as training duration, intensity, frequency, and exercise selection remain inconsistent in the existing literature. Another limitation of the current literature is the lack of investigation into the combined effects of multiple RE modalities on anaerobic and balance performance within a single structured training session. In addition, the potential contribution of underlying physiological and neuromuscular factors, such as ankle flexibility and shin muscle strength, to improvements in postural stability has received limited attention in youth football players. Therefore, further research is required to clarify the effectiveness of integrated RE programs that combine different neuromuscular training modalities in improving anaerobic and balance performance in young football players.

Aim of the Thesis

To evaluate the effects of an eight-week combined RE programs integrating self-loading, balance and plyometric on anaerobic and balance performance in well-trained young male football players aged 14–16 years competing at regional and national levels.

Objective of the Thesis

To achieve the aim of doctoral thesis, the following objectives are established:

1 To conduct a literature review related to the effects of RE on anaerobic and balance performance in young male football players. This review aims to map the existing scientific evidence on different RE modalities and their effectiveness in improving anaerobic and balance, including training protocols such as duration, intensity, frequency, set, and repetitions.

2 To analyse anaerobic and balance characteristic according to playing position in well-trained young male players aged 14–16 years (Tanner stage 3–4), with approximately 8 years of training experiences, and competing at regional and national levels. Anaerobic measures include the six-second peak power output (6PPO) and the Wingate Anaerobic test (WAnT) with variables peak power output (PPO), mean power (MP), fatigue index (FI), and countermovement jump (CMJ) test (HJ, TF, and MF). Balance measures include static and dynamic balance test. This analysis is conducted prior to designing the RE programs to determine whether training intervention for young players should be tailored according to the physical

demand of different playing positions: Goalkeepers (GK), Defenders (DEF), Midfielders (MD) and Forwards (F).

3 To identify asymmetry between D and ND leg during a 30-seconds one leg stance in static and dynamic balance assessments. Static balance variables include EA, P, APD, MLD, AAPS, and AMLS. Dynamic balance variables include TTD and TSI. The findings will be used to inform the appropriate design of dose-response of RE programs based on individual characteristics of the participants.

4 To evaluate the effects of an eight-week combined self-loading, balance, and plyometric exercises on: (a) anaerobic performance indicators, (b) balance-related variables, (c) ankle range of motion (plantar and dorsiflexion), and (d) peak isometric lower-leg muscle strength in well-trained male young football players.

Hypothesis of the Thesis

An eight-week combined RE programs integrating self-loading, balance and plyometric training will significantly improve anaerobic and balance performance in youth male football players aged 14–16 years.

Novelty of the Thesis

Although numerous resistance exercise (RE) programs have been widely studied in youth footballers, limited research has examined how specific RE protocols and modalities affect anaerobic performance and balance-related variables, including ankle flexibility and peak isometric shin muscle strength in young population. Considering the high anaerobic demands of football matches (Nobari et al., 2023) and the high percentage of lower-extremity injuries in youth players (71–80 %) (Read et al., 2016), with a 20 % proportion of ankle instability (Francia et al., 2022; Park et al., 2024), targeted development of anaerobic capacity, balance, and ankle mobility is essential during this age period stage. This thesis addresses this gap by investigating the effects of RE programs based on the PROCESS training principles on anaerobic performance and balance in youth football players aged 14–16 years, thereby contributing to improved training strategies for enhancing physical fitness and functional movement in young athletes.

Ethical Aspects

The study was conducted in the Riga region, Latvia, from 2022 to 2024. The research protocol was prepared in accordance with all National regulations and institutional policies and followed the Declaration of Helsinki. It was approved by the Ethics Committee of the Latvian Academy of Sport Education (meeting Protocol No. 6, Decision No. 1/51813, 24 February

2023). The study protocol was implemented and reported in accordance with the Standard Protocol Items: Recommendations for Intervention Trials (SPRIT) statement. Parental and participant consents were obtained after a thorough explanation of the study's purpose, procedures, risks, and benefits. The participants read and signed a consent form approved by Latvian Academy of Sports Education Ethics Committee.

Population Study

Young male football players (age = 14–16 years), classified as Tanner stages 3 and 4, were included to exclude the influence of a growth spurt on the footballers' performance. Participants were randomly assigned to intervention (IG) and control (CG) groups. We used Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) to randomly assign 30 players to each group using the formula = SORTBY (SEQUENCE (30), RANDARRAY (30, 1, 1, 30, TRUE). No statistically significant differences were detected between IG and CG regarding mean age, training experience, volume, and anthropometric data. Parental and participant consent was obtained after a thorough explanation of the study's purpose, procedures, risks, and benefits.

Resistance Training Program

The resistance exercise program consisted of balance and plyometric training, as well as self-loading training. Anaerobic performance implemented resistance exercise (RE) that combined plyometric and self-loading. Similarly, RE was implemented for balance, ankle mobility, and explosive strength as part of balance and plyometric training. Subjects were carefully instructed before the intervention, received a practical demonstration, and performed a familiarization exercise. In an anaerobic study, IG performed plyometric exercises (hurdle jumps, lateral hurdle jumps, bouncy strides, and single-leg hop jumps) followed by a 20-metre sprint and self-loading training (isometric squat, deep squat, lunge, side lateral lunge, single-leg squat left/right, weight displacement, and maximal speed with partner resistance).

Balance training consisted of four types of exercises: 1) maintaining a static position with semi-squatted legs, both single and double leg, while holding a medicine ball in the hands; 2) squatting and throwing the medicine ball vertically upwards, then standing up and catching the ball; 3) standing and maintaining a balanced position on the wobble board with a resistance band positioned around the thighs above the knees; 4) standing and maintaining a balanced position on the roller balance board with a resistance band positioned around the shins below the knees. The dose-response for balance training followed the protocol outlined by Gebel et al (Gebel et al., 2020). Each exercise lasted 20–40 seconds, with 3 repetitions in each set, a 30-second break between each set of exercises, and a 120-second rest period between different exercises.

Plyometric training consisted of four types of exercises: 1) countermovement jumps on both legs over the hurdle, 2) hops on the right and left legs above the hurdle, 3) single-leg jumps forward and backward, side to side in front of a cone, and 4) skipping rope on both legs and on a single leg. Based on the recommendations of Bedoya et al. (2015), plyometric exercises were performed in 2 to 4 sets of 6 to 15 repetitions per set. The rest intervals between each set and different exercises were 60 to 120 seconds. The initial number of ground contacts per session was set at 50 to 60, with progression leading to a maximum of 80 to 120 contacts per session. During the intervention, balance training was performed before plyometric exercises to achieve optimal functional movement and muscular fitness outcomes (Behm et al., 2008; Granacher & Behm, 2023).

Data collection

The study used 1) a ProKin 252 stabilometric platform (TecnoBody, Dalmine, Italy) for static and dynamic balance, 2) a cycle ergometer (Wattbike Pro, Nottingham, UK) for the Six-second peak power output test (6PPO) and the Wingate anaerobic test (WAnT), 3) Optojump (Microgate, Srl., Bolzano, Italy) and a force plate BTSP-6000 (BTS Bioengineering, Garbagnate Milanese, Italy) for the countermovement vertical jump, 4) a Jamar Plus digital goniometer (Performance Health, United Kingdom) for ankle range of movement in plantar and dorsal flexion, and 5) a handheld dynamometer (MicroFET2; Hogan Health Industries Inc., Draper, UT, United States) for the shin muscles' peak isometric strength test.

All devices and platforms used in this research have demonstrated validity and reliability in measuring peak power output on the bicycle ergometer (Herbert et al., 2015; Wehbe et al., 2015), short-term strength endurance on the bicycle ergometer (Nikolaidis & Knechtle, 2021; Nikolaidis et al., 2016), vertical jump for muscle strength and power investigation (Bellicha et al., 2022; Glatthorn et al., 2011), static and dynamic balance (Srishti et al., 2023), ankle range of motion (Lind et al., 2022), and the' peak isometric strength of shin muscles (Kolber & Cleland, 2005).

Effect of intensive resistance exercises on anaerobic and balance performance

The first study aimed to analyse variation in anaerobic and balance performance according to playing position (GK, DEF, MD, and F). Our findings revealed that the F positions are significantly different from the MD ($p = 0.003$), with the leg muscle peak power output in F greater than in MD (195 watts higher). There was no significant interaction of PPO among goalkeepers, defenders, and forwards. The current study proved that no significant differences in vertical jump characteristics (height, flight time, and maximum force) across player positions ($p = 0.11–0.31$). Although GK has a lower sway speed in the ML direction (24–27 mm/s) than other groups ($p = 0.02$), overall, there is no significant difference in static and dynamic balance between playing positions.

The second study aimed to identify asymmetry between D and ND legs in static and dynamic balance, as well as the relationship between static and dynamic balance parameters. The present study revealed no difference between both legs in static balance variables: EA, P, AAPS, and AMLS ($p = 0.33–0.72$), as well as in dynamic balance characteristics: TSI and TTD angle ($p = 0.73–0.78$). Furthermore, our study revealed no correlation between static and dynamic balance parameters, except for TTD and EA ($r = 0.332$; $p = 0.03$), TTD and MLD ($r = 0.335$; $p = 0.02$), and TTD and TD ($r = 0.423$; $p = 0.01$). Static and dynamic balances are related to the control of body centre of pressure displacement, but the two balance expressions are not interchangeable.

The third study aimed to evaluate the effect of RE combined (self-loading and plyometric training) on anaerobic performance. IG demonstrated significant improvements in peak power output (PPO) during the 30-second Wingate Anaerobic test ($p = 0.000$, $d = 1.53$) and the six-second peak power output test ($p = 0.001$, $d = 1.57$). Moreover, other anaerobic performance variables, including relative PPO and mean power (MP), improved significantly ($p = 0.006$* and $p = 0.00$, respectively). Consistent with IG, CG, which engaged solely in standard training, exhibited enhancements in PPO for the 30s Wingate Anaerobic test (WAnT) ($p = 0.025$) and 6s PPO ($p = 0.002$). However, no significant changes were observed in the fatigue index (FI) for both groups (IG = 0.227 and CG = 0.249), indicating that although peak power output improved, the ability to sustain high-intensity effort throughout the 30-second WAnT remained unchanged.

The fourth study aimed to evaluate the effect of combined RE (balance and plyometric training) on balance, ankle mobility, and jump performance. After conducting the RE program for eight weeks, IG significantly improved all static and dynamic balance parameters ($p = 0.001–0.045$, $d = 0.5–1.14$). Active range of motion for plantar flexion increased by 5° (13 %), and dorsiflexion by 4° (32 %) in the IG ($p = 0.001–0.02$). Maximal voluntary isometric strength of the shin muscle increased in plantar flexor muscle absolute peak force ± 14 N (10 %), relative peak force ± 5 N/kg (15 %), and relative peak torque ± 0.6 N.m/kg (14 %), with moderate effect size ($p = 0.001–0.038$, $d = 0.45–074$). Countermovement jump (CMJ) revealed significant improvement in height jump (HJ) for IG ($p = 0.000$; $d = 1.27$) and CG ($p = 0.008$; $d = 0.82$). Moreover, IG showed significant improvement in flight time ($p = 0.017$; $d = 0.82$) and maximum force production ($p = 0.004$; $d = 1.07$).

Conclusions

1 The literature review identified fourteen studies examining the effects of resistance exercise on anaerobic and balance performance in young football players. The evidence indicates that combined RE programs, particularly integrating plyometric with regular football training significantly improve anaerobic performance and balance-related variables. High-quality studies suggested that optimal adaptations occur following approximately eight weeks of training, performed 2–3 times per week on non-consecutive days, at moderate-to-high intensity, with a volume of 2–3 sets of 6–12 repetitions per exercise. Overall, these findings confirm that integrating RE into regular football training enhances key performance components, including sprinting, jumping, and change-of-direction ability, while also improving balance, as evidenced by reductions in centre-of-pressure displacement and postural sway.

2 Anaerobic and balance performance according to playing position.

a. PPO significantly differed significantly among playing positions, with forwards position demonstrating significantly higher PPO compared to midfielders.

b. No significant differences were observed among four playing position groups in CMJ variables including peak force production, height jump, and flight time.

c. Although GK position demonstrates slower average medial-lateral speed (AMLS) than F position, overall, all groups have similar static and dynamic balance characteristics.

d. To improve anaerobic and balance performance in young players, these findings suggest that RE programs including duration, intensity, volume, set and repetition can be designed in a generalised manner for all players, regardless of playing position.

3 Identification of asymmetries between the dominant (D) and nondominant (ND) legs in young football players and the relationship between static and dynamic balance

a. Young players in this study showed symmetrical between both legs, with no significant differences between D and ND legs in static and dynamic balance.

b. However, the pre-assessment revealed that participants experienced limited dynamic balance proficiency (TSI=2.35). Therefore, the design of RE intervention should be included balance, core stability, or proprioceptive training to improve overall balance quality.

c. As static and dynamic balance was uncorrelated, both components should be evaluated separately to provide comprehensive information about balance proficiency in young population.

4 Effects of 8-week combined RE programs integrating self-loading, balance and plyometric on anaerobic and balance performance

a. The combined RE program (self-loading and plyometric training) alongside regular football training significantly enhanced anaerobic performance in young football players, as evidenced by improvements in peak power output (PPO) and mean power (MP).
b. However, no significant changes were observed in fatigue index (FI), indicating that while peak power output improved, the ability to sustain high-intensity effort throughout the 30-second WAnT remained unchanged.
c. The combined balance and plyometric training program significantly improved static and dynamic balance in young football players, as evidenced by reductions in centre of pressure (COP) displacement, sway speed, and improved trunk stability.
d. Improvements in ankle range of motion and peak isometric strength of plantar and dorsiflexion muscles further support the effectiveness of RE in enhancing neuromuscular function and proprioceptive feedback.
e. The integration of plyometric training improved vertical jump performance through increased motor unit recruitment and stretch-shortening cycle efficiency.

Practical recommendation

This study provides scientific validation for the implementation of intensive RE within a structured training program, emphasizing an appropriate dose-response relationship for young football players. Coaches are recommended to implement RE programs including balance, self-loading, and plyometric training based on an integrative neuromuscular training approach with multifarious movement to improve balance and anaerobic performance in young athletes aged 14–16 years. To sustain performance improvements, coaches are encouraged to apply similar this RE protocols during the preseason, followed by appropriate adjustments in training frequency, volume, intensity, and duration throughout the competitive season.

Prior to implementing balance and plyometric training protocols, practitioners are advised to conduct preliminary assessments to evaluate symmetry between dominant and non-dominant limbs and to determine an appropriate RE dose-response relationship. In addition, strength and conditioning practitioners should emphasise integrative neuromuscular training approaches rather than isolated training programs based on playing position.

Proposals

This study proposes an integrated resistance exercise (RE) approach that combines self-loading, plyometric, and balance training to enhance anaerobic performance and neuromuscular function in young football players. The proposed RE program consists of an 8-week intervention, with sessions performed twice weekly on non-consecutive days. Each session included 2–4 sets of 6–15 repetitions at moderate to high intensity and lasted approximately 30–40 minutes. Progressive overload was applied by systematically increasing intensity, volume, level of difficulty, and duration every two weeks.

The integration of self-loading resistance with balance and plyometric training demonstrated improvements in balance, ankle range of motion, shin muscle isometric strength, and jump performance in young football players. Furthermore, the combined self-loading and plyometric improved peak power output and mean power but did not significantly affect fatigue index. Future research should examine additional training components, such as repeated sprint or additional strength endurance training, to further enhance fatigue resistance

If balance and plyometric exercises are conducted in a single training session, balance exercises should be performed before plyometric to optimize functional movement and enhance proprioceptive afferent responses, thereby promoting faster and greater neuromuscular activation during plyometric exercises.

Publications and reports on topics related to the Doctoral Thesis

Publications:

1. Sinulingga, A. R., Pontaga, I., & Slaidiņš, K. (2024). An assessment of static and dynamic balance effectiveness in one-leg stance of young footballers. *Human Movement*, *25*(2), 97–104. https://doi.org/10.5114/hm/186752
2. Sinulingga, A. R., & Pontaga, I. (2024). A Review of the Effect of Resistance Exercise on the Development of Anaerobic and Balance Performance in Adolescent Footballers. *International Journal of Kinesiology and Sports Science*, *12*(4), 8–20. https://doi.org/10.7575/aiac.ijkss.v.12n.4p.8
3. Sinulingga, A.R., Pontaga, I., & Slaidiņš, K. (2025). Analysis of peak power output, lower limb explosive strength, and balance performance of young football players according to their playing position: A pilot study. Sport i Turystyka. Środkowoeuropejskie Czasopismo Naukowe, 8(1), 97–114. http://dx.doi.org/10.16926/sit.2025.01.05
4. Sinulingga, A. R., Slaidiņš, K., Salajeva, A., Liepa, A., & Pontaga, I. (2025). Effect of Integrative Balance and Plyometric Training on Balance, Ankle Mobility, and Jump Performance in Youth Football Players: A Randomized Controlled Trial. Physical Activity and Health, 9(1), pp. 146–160. https://doi.org/10.5334/paah.472

Reports and theses presented at international congresses and conferences:

1. Correlation between Sprint Cycle Ergometer and Vertical Jump Test Results to Determine Anaerobic Performance in Young Football Players. 22nd Annual Scientific Conference of the Montenegrin Sports Academy: "Sport, Physical Activity, and Health: Contemporary Perspectives." **Dubrovnik, Croatia, 3–6 April 2025.** https://www.mjssm.me/?sekcija = article &artid = 505
2. Assessment of Correlation between Dynamic Balance, Flexibility of Ankle Joints, and Shin Muscles Peak Isometric Strength in Adolescent Football Players. International Research Conference on Medical and Health Care Sciences, RSU research. **Riga, Latvia, 26–28 March 2025.** https://rw2025.rsu.lv/sites/default/files/documents_en/RW2025_Abstract-Book-KUP.pdf
3. Effect of Resistance Training on Anaerobic Performance and Dynamic Balance of Young Football Players: The 17th Conference of Baltic Society and Sport Science, **Tartu, Estonia, 24–26 April 2024**. https://sporditeadused.ut.ee/et/sisu/17th-conference-baltic-society-sport-sciences
4. Anaerobic Performance and Balance in Young Football Players: A Pilot Study," The 16th Conference of Baltic Society and Sport Science: "Current Trend in Sport Sciences and Physical Education", **Poland, May 25–26, 2023**. https://science.rsu.lv/ws/portalfiles/portal/95693708/Book_of_abstract_BSSS_2023.pdf
5. Anaerobic Performance and Balance in Young Football Players: A review. The 15th International Scientific Conference of doctoral and master's students of the Latvian Academy of Sports Pedagogy in sports science, **Riga, Latvia, 2023**. https://lspa.lv/images/Augstu_sasniegumu_sports_2023.pdf

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