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Theses of the Doctoral Dissertation

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Motoros képességek teljesítményösszetevőinek vizsgálata utánpótláskorú labdarúgóknál

Az edzésen kialakított képességek hatása a mérkőzés eredményességre

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Introduction

Football teams have begun to use GPS -based tracking techniques over the past decade to determine the objective external load (Wehbe et al., 2014). External load is the projection of physical requirements for training. This load group is divided into two major categories (Marczinka et al., 2019):

• Locomotor load (speed, distance)

• Mechanical load (IMA).

Movements that contain a change of direction, start, stop, or jumps are called mechanical load (Impellizzeri, 2019). In recent years, the focus has been on match analysis in football, due to the development of increasingly delicate satellite positioning systems (Aughey, 2011). GPS systems have been spread in sports for physical parameters (Gray et al., 2010; Aughey, 2011). Many parameters can be detected, e.g. The distance, speed, accelerations, decelerations, etc. (Malone et al., 2017).

The largest professional revolution in performance monitoring in football (also) GPS systems primarily the importance of the muscles of thighs and legs and thus all-body micro-movements (Osgnach et al., 2010; Cummins et al., 2013; Lacome et al., 2017; Silva et al., 2022). In matches, up to 8 cods per minute can be expected for adults (Bloomfield et al., 2007). It is important for accelerations and decelerations in the case of recruitment (also) that they trigger more metabolic and mechanical loads than permanent speed runs (Hader et al., 2016). During workouts, SSGs exercises increase the number of accelerations and decelerations (Martín-Garcia et al., 2019; Zurutuza et al, 2020). In football, the appearance of linear speed is not constant, but rather to be interpreted as an effective multidirectional movement (Fitzpatrick et al., 2019). Agriculture is dominated by effective start and stop, but unlike closed -end speeds ("quickness"), you need to make acyclic movements with the current environmental changes in response to a stimulus (Sheppard & Young, 2006; Young et al., 2021). We call it agility (Schandl, 2018). Agility is a "fast and accurate whole-body movement that results in a change of speed, direction or movement pattern in response to a stimulus" (Jones & Nimimchius, 2018: 145). If, on the other hand, there is no need to decide, but change the direction during movement and the route can be planned, we are talking about directional ability (Csáki & Takács, 2020). The fundamental difference between the two abilities is thus reflected in environmental conditions (Matlák et al., 2016).

Aim and questions

The purpose of the dissertation is to investigate the performance and measured data of athletes in the academic system through a whole season. The research included U16 and U17 age groups. We would like to provide methodological assistance to age group training and to provide coaches how to interpret the values that they received. Another important area for explaining the results, is how the parameters of the measurement can be set to serve efficiency. The interpretation of the data allows you to develop individual development plans and to develop the most characters of the post. In the context of a longitudinal study, we follow the development of the teams and the individual during the season. During the research, we examine the championship year by separating the autumn and spring semester. Development is monitored for both physical parameters, motor track tests, and training and match monitoring. Among the goals of the Academy is to reach international levels for footballers. Based on the tests to be surveyed, it is expected that they can be successfully included in various human biological indicators and motor rehearsals.

Q1: Where do the effectiveness of the parameters examined rank in international comparison?
H1: The players' results in human biology and motor track tests are internationally relevant.
We conduct a longitudinal study to track the progress of teams during the league season. The progress is monitored in terms of physical parameters, motor track tests, training, and match monitoring.
Q2: How will the teams studied develop during the league season?
H2: As a result of planned skill development, the measured motor skills show an increase between different age groups (U16 and U17) compared to autumn and spring measurements.
In addition to basic training, players receive post-specific training with sufficient frequency. The academy places great emphasis on general preparation, which has several advantages. The athlete can be included in several roles, and the special training starts from a more stable foundation, but at the same time, professional football requires the acquisition of the qualities characteristic of the positions.
Q3: What are the differences in the skills of players in different positions based on training performance?
H3: Athletes' averages vary significantly based on positions in the game based on weekly training loads.

An important element of the dissertation is the effect of training load on match performance. From a pedagogical point of view, the task of training load is to prepare athletes for the requirements dictated by the match. Based on external load indicators, we examine the relationships between training and match performance.

Q4: What is the relationship between training load and match load?

H4: Based on the professional work of the academy, weekly training loads prepare footballers for match loads.

Video analysis of the players judged by the coaches to be the most talented will be carried out on a team-by-team basis throughout the league season. During the individual video recording analyses, the specifics characteristic of the posts is drawn, which means the meeting of matches with the ball. The results obtained can be the starting point for later post-specific preparation.

Q5: Based on the individual video recording, what are the differences between the two age groups in terms of meeting the ball and technical execution in different parts (positions)?

H5: Based on video analysis, there are significant differences in the type of encounter with the ball according to posts.

The main condition for the success of football is the paradox that from the point of view of training theory a high level of contradictory skills is necessary at the same time. We are looking for the answer to this problem due to the special preparation of players.

Q6: Can there be a close relationship between physiologically different types of abilities at the same time?

H6: Point cloud diagrams show that there is a strong correlation between energetically different capabilities.

The aim of the research is to develop a professionally relevant performance profile for coaches. Through easy-to-understand profiles, we try to help coaches in the multidimensional measurement system in which athletes participate. The performance profile allows for both sport-specific and post-specific selection. These are decisive factors for future success.

Q7: What are the dominant motor traits (field tests and match load) in the development of the performance profile that cover the two age groups studied and the talented players?

H7: It is assumed that in the performance profile figures compiled based on the skills and external load indicators to be assessed, the results of talented players will be higher than the team averages.

Methods

Research ethics

Research ethics license number: ELTE PPK KEB 2020/20. Modified 14.04.2023 ELTE PPK KEB 2020/20-02. Based on the permission, we were given the opportunity to analyze the data secondly.

Participants

The sampling site is a football academy in Western Hungary. Age groups included in the study: U16, U17. N=45. The teams include goalkeepers, defenders, midfielders, and attackers, proportionally distributed by post. The study included those youth footballers who are considered age groups eligible for the special Sports Academy status stipulated by law.

Tests

During the motor tests and the change in body composition, we considered the variables of the *Football Specific Measurement Test System* required by the National Sports Agency (NSÜ) Non-profit Private Limited Company on behalf of the Ministry of Defence. These measurement test batters apply to sports academy age groups. It was developed by the Puskás Academy Methodological Center (Csáki, 2020). In 2019, based on Government Decision 1656/2019 (XI.21.), the academy received the status of Sports Academy, which guarantees a unified regulatory and quality assurance system for sports organizations belonging to this category(http://www.kozlonyok.hu/nkonline/index.php?menuindex=200&pageindex=kozltart &ev=2019&szam=187). The tests surveyed are part of the academy's testing procedures, internationally accepted, standardized pitch tests in football, and were nothing new for players. The content of the data can be divided into the following groups: (1) training and match performance monitoring, (2) conditioning measurement, (3) human biological measurement, (4) medical measurement, (5) video recording analysis.

Tools and methods used in research

Performance monitoring (external load indicators): CatapultOptimEyeS5

- Conditioning measurements:
- Locomotor speed test (5 m, 10 m, 30 m): Witty Wireless Training Timer Photocell
- Sport-specific endurance: Yo-Yo Intermittent Recovery Test Level 1 (YYIR1) audio
- Ability to change direction (Illinois Test (IAT); COD505): Witty Wireless Training Timer Photocell
- Isokinetic dynamometer to assess leg strength: HumacNorm isokinetic dynamometer
    - Balancing ability: ProKin-E stabilometer

o   Explosive power measurement: Standing Long jump from location (tape measure)

- Human biology measurement: Body composition measurement: InBody 770 instrument

- Medical measurement: Functional Movement Screen (FMS) set

- Video recording analysis: Hudle Sportcode.

Data processing

IBM SPSS Statistic for Windows, Version 28 is used to evaluate the measured data (Csallner, 2015). After adding the data, we carry out the process of data cleaning, paying special attention to outliers and extreme values. In connection with univariate analyses, mean, standard deviation values are considered. In multivariate analyses, the significance of single-aspect analysis of variance (ANOVA) within and between teams is examined, followed by correlation matrix analysis with Pearson's correlation ($p < 0.05$). By analyzing the values of variables that fit into the point cloud, we examine the relationship between two different capabilities. The radar chart illustrates the evolution of performance profiles.

Results

Results for hypothesis 1:

In the following human biological and conditioning parameters, the results of the two age groups (U16, U17) achieve the performance expected at international level: *body composition variables* (9 pcs), *locomotor speed* test (30m), *sport-specific endurance* (YYIR1), ability *to change direction* (IAT test), *explosive power* ability (HT test), *Functional Movement Screen* (FMS) test. What we did not find results approaching the international level: *ability to change direction* (COD505 test), *Counter-Movement Jump* (CMJ test), *total distance values traveled* in matches.

Results for hypothesis 2:

During the spring measurements, progress was made in the following variables and abilities related to autumn measurements: *human biology measurement*, *locomotor speed* test (30m), *sport-specific endurance* (YYIR1), *ability to change direction* (IAT test), *explosive power* capability (HT test), *Functional Movement Screen* (FMS) test, *leg strength tests measured by an isokinetic dynamometer*. There was stagnation or decline in the spring in connection with the *COD505 test* and the stabilometer *balancing ability* tests.

Results for hypothesis 3:

During the weekly training load of players by position, the following trend can be summarized: U16: defenders have the highest *total distance* indicator; the *meterage per minute* by midfielders is the most intense; the number of meters spent by attackers *in zones above 19.8*

km/h is the most significant; The *acceleration* (Acc) and *deceleration* (Dec) indicators of attackers are significant in the sample studied. U17: the number of meters defenders spend *in the sprint zone* (over <25.2 km/h) exceeds the average for other positions; *maximum speed* values are post-independent; midfielders have explosive *actions* that outnumber teammates; attackers' *Total Player Load* is below average for other positions.

Results for hypothesis 4:

Based on the relationship between training and match performance, training and match variables are closely correlated in the same external load group (e.g., U16 locomotor load: *maximum speed*, training and match indicator: r=0.879; p=0.000). Within external load indicators, we also found a correlation between training and match variables (e.g. U17 mechanical load: Total Player Load training index and *Player Load/min* match indicator: r=0.543; p=0.009). The correlation of locomotor load parameters is stronger than mechanical load indicators. Autumn measurements show closer joint movement than spring measurements.

Results for hypothesis 5:

During the video recording analyses (44 matches; monitoring 3-3 players per team), we found the following dominant post-specific technical implementations to be the most pronounced in the two age groups: defenders: *ball acquisition, free ball acquisition, constructive pass, ball holder*. Midfielders: *goal, feinting, shooting, ball passing, free ball acquisition*. Attackers: *goal, feinting, shoot, ball pass, dribbling*.

Results for hypothesis 6:

During the point cloud chart analyses, it can be established that the *Total Distances* and the *Total Player Load* training indicators are stronger together in the U17 age group, while in the U16 age group there is a more moderate correlation, which can be read in connection with the straight lines that fit on the point cloud. The *variables* of high intensity acceleration and high *intensity deceleration* are related in both age groups, more dominant in the U16 age group and more moderate in the U17 age group. The movement of distance *meterage per minute* and *explosive actions* is stronger than the U17 age group and weaker than the U16 age group can be observed on the point cloud chart. The *ability to change direction* (IAT test) and the *locomotor speed* test (30m) were closely correlated in the U17 age group, while no relationship was found between the parameters in the U16 age group.

Results for hypothesis 7:

We plotted 28 performance profiles with radar diagrams. The profiles of the 3-3 most talented athletes selected by the coaches per team section exceed the team averages of the two age groups in most of the parameters examined. This has been proven both in external load

indicators and in sport-specific abilities. The defender and midfielder of the U16 age group stand out in the sample studied. The high quality of physiologically different abilities (from the point of view of energy base) was also confirmed in connection with the radar diagrams of external load indicators and sport-specific abilities.

Discussion

Hypothesis testing

H1: The players' results in human biology and motor track tests are internationally relevant.

Based on the comparison, it can be concluded that the results obtained in the examined sample were predominantly equal to the values expected at international level in international comparison.

The H1 hypothesis has been partially confirmed.

H2: As a result of planned skill development, the measured motor skills show an increase between different age groups (U16 and U17) compared to autumn and spring measurements.

A longitudinal study during the championship season shows that most of the abilities improve during the season, although not all variables have been proven.

Our H2 hypothesis has largely been confirmed.

H3: Athletes' averages vary significantly based on positions in the game based on weekly training loads.

We did not find any significant difference between averages per post. Deviations between averages are of a tendency nature.

The H3 hypothesis is rejected.

H4: Based on the professional work of the academy, weekly training loads prepare footballers for match loads.

The relationship between locomotor and mechanical load training and match load can be shown to be different in strength between autumn and spring. In some cases, there is a stronger, in some cases weaker, correlation between training and match load when examining the two league halves separately.

The H4 hypothesis can be considered partially true.

H5: Based on video analysis, there are significant differences in the type of encounter with the ball according to posts.

There are significant differences in the way players in different positions meet the ball.

The hypothesis H5 is considered justified.

H6: Point cloud diagrams show that there is a relationship between energetically different capabilities.

Based on the point cloud diagrams, it can be concluded that there is a correlation between the performances performed in different motorcycle track tests. Similar results can be said about the co-movement between external load indicators.

The H6 hypothesis can be considered partially true.

H7: It is assumed that the performance profile figures compiled on the basis of the skills and external load indicators to be assessed show a higher value for the results of the most talented players than the team averages.

With the help of the radar chart, we proved that the values of players with outstanding abilities from teams exceed team averages.

The hypothesis H7 is considered proven.

Methodological guide

Based on the results obtained, we have formulated an ideological guide that covers

(1) general recommendations, (2) age group (U16, U17) specific. The recommendations enable more effective, age-specific training planning. Methodological recommendations consider state-of-the-art theories (Oliver & Harrison, 2020; Vass, 2020). The proposals are based on international literature. Post-specific preparation can be developed based on what has been described. The recommendations reflect a preventive approach.

Summary, outlook

Knowledge of the motor performance structure of football in youth age is essential (Csáki, 2017). The development and monitoring of motor skills together support the harmonious development and successful performance of the athlete (Soós, 2022). In recent decades, the interdisciplinary-based approach has also reached training theory, thus also the preparation of youth athletes (Williams, 2000). As a result, it tries to influence the development of athletes by involving several disciplines. In our research, we focused on the performance group among the traditional performance components. In our study, a particularly important age stage was observed in a longitudinal study. U16 and U17 footballers undergo quantitative and qualitative changes during this period, where the effect of targeted training stimuli is an important imprint of their subsequent performance (Lloyd & Oliver, 2012). When mapping the skills and abilities needed to become an effective footballer, we looked at a broad spectrum of ability structures. The most modern tools currently available helped to achieve this. The content of the obtained data can be divided into several groups. A particularly valuable part of the dissertation is the locomotor load data (training and match) obtained by global positioning systems (GPS) and the

weekly averages of mechanical load indicators (IMA microsensor) measured based on the same variables, which were examined over a full season. Based on the data received, we developed a performance profile for coaches. The profile is interpreted in two areas: data obtained during motorcycle track tests; and external load indicators measured during match performance. Such a comprehensive investigation was previously the privilege of professional adult athletes. Knowledge of these data has implications for various areas of sports science: skill development, periodization, individual development, and fitness conditioning work (Bompa & Carrera, 2015). The effect of skills developed during training on the match appears as a pedagogical goal for any specialist. This is where the results of his work can really be seen. By knowing the goal-content-method, the training system that is the multifacetedly prepared football ideal becomes effective. Football is a game of opposites, coaches say, because both in terms of motor skills and physiological characteristics, it is the seemingly paradoxical opposite of several abilities and skills, and at the same time its high level ensures performance (Stølen et al., 2005). We tried to map and summarize this variability during the dissertation. During our work, general training theory and methodology helped our investigations. The aim of the dissertation is to provide a comprehensive picture of the changes in the performance structure of motor skills in the academic system for junior athletes.

New findings of the research

- In Hungary, youth footballers have never been examined in such a versatile and complex way in the form of doctoral dissertations.

- Such large-scale capability monitoring has not yet taken place in a longitudinal study.

- In the study, state-of-the-art, globally unique equipment was available for the research.

- The development of a performance profile for youth footballers can be considered a pioneering achievement.

- Weekly averages of athletes' external load indicators for an entire championship season were not available to specialists in the literature.

- Training methodology recommendations compiled since the obtained data, based on real training and match measurement results, which cover a whole season, cannot be found in the Hungarian literature.

Future directions of research

Based on the equipment available at academies, it is a realistic goal to extend the assessed capabilities and external load indicators to a national scale. In addition to the two age groups, it would be worth including younger (e.g., U15) or older (e.g., U19) age groups. In this case,

the performance profile could be standardized, thus facilitating the selection and preparation process.

It would also be feasible to align the external load indicators measured during matches with the video recording analysis process. In this way, the physical performance delivered could be evaluated in a match context. This effort would also help the work of coaches.

The presence of global positioning systems (GPS) can determine many interesting, exciting directions of research:

- When planning trainings and training exercises, knowledge of already known physical requirements and effects, thereby standardizing training exercises and facilitating the planning of periodization

- replacing motor track tests (e.g., YYIR1) with more sport-specific tests (e.g., standardized SSGs), where progress could be tracked and measured in football-specific exercises.

- Development of reactive agility trajectories linking load and cognitive processes

- special post training with load indicators typical of a particular post.

- Knowledge of the ratio of locomotor load (basically cyclic locomotor structure) to mechanical load (predominantly acyclic locomotor structure) during the match would provide interesting and valuable information. This would help to plan training methodology aspects.

Bibliography

Aughey, R.J. (2011). Applications of GPS technologies to field sports. *Int J Sports Physiol Perform*, *6*(3), 295-310. https://doi:202010.1123/ijspp.6.3.295

Bloomfield, J., Polman, R. & O'Donoghue, P. (2007). Physical demands of different positions in FA Premier League soccer. *Journal of Sport Science and Medicine*. 6,63–70.

Bompa, T. & Carrera, M. (2015). *Conditioning young athletes*. Human Kinetics.

Cummins, C., Orr, R., O'Connor, H. & West, C. (2013). Global Positioning Systems (GPS) and Microtechnology Sensors in Team Sports: A Systematic Review. *Sports Medicine, 43*(10), 1025–1042.

Csáki, I. (2017). A magyar elitképzésben résztvevő utánpótlás korú labdarúgók poszt és korosztályspecifikus vizsgálata. PhD- értekezés. Testnevelési Egyetem

Csáki, I. (2020). Mérési rendszer a Puskás Akadémián. *Puskás Akadémia Szemle*. 2(1), 36-41.

Csáki, I. & Takács, M. (2020). *Labdarúgás és Tudomány*. Pro-Kvóta Kft.

Fitzpatrick, J.F., Linsley, A. & Musham, C. (2019). Running the Curve: a preliminary investigation to curved sprinting during football match-play. *Sport Perfomance & Science Reports*. 55(1), 1-3.

Gray, A.J., Jenkins, D., Andrews, M.H., Taaffe, D.R. & Glover, M.L. (2010). Validity and reliability of GPS for measuring distance travelled in field-based team sports. *J Sports Sci*. *28*(12), 1319-25. https://doi: 10.1080/02640414.2010.504783

Hader, K., Mendez-Villanueva, A, Palazzi, D, Ahmaidi, S. & Buchheit, M. (2016). Metabolic power requirement of change of direction speed in young soccer players: not all is what it seems. PLoS ONE. *11*(3), 1–21. doi:10.1371/journal.pone.0149839

Impellizzeri, F.M., Marcora, S.M. & Coutts, A. J. (2019). Internal and External Training Load: 15 Years On. *International Journal of Sports Physiology and Performance,14*(2), 270-273. *1–4*. doi:10.1123/ijspp.2018-0935

Jones, P.A. & Nimphius, S. (2018). *Perfomance Assessment in Strength and Conditioning*. Routledge.

Lacome, M., Simpson, B.M., Cholley Y., Lambert, P. & Buchheit, M. (2017). Small-Sided Games in Elite Soccer: Does One Size Fit All? *Int J Sports Physiol Perform*, *13*(5), 568-576. https://doi:10.1123/ijspp.2017-0214

Lloyd, R.S. & Oliver, J.L. (2012). The youth physical development model. *Strength Cond J*, *34*(3), 61-72

Malone, J.J., Lovell R, Varley, M.C. & Coutts, A.J. (2017). Unpacking the Black Box: Applications and Considerations for Using GPS Devices in Sport. *Int J Sports Physiol Perform*, *12*(2), S218-S226. https://doi: 10.1123/ijspp.2016-0236.

Marczinka, Z., Pozsonyi, Zs. & Schuth, G. (2019). *Erőnléti edzés a kézilabdázásban*. Kék Európa Stúdió.

Martín-García, A, Castellano, J, Méndez Villanueva, A, Gómez-Díaz, A, Cos F. & Casamichana, D. (2020). Physical demands of ball possession games in relation to the most demanding passages of a competitive match. *J Sports Sci Med*, *19*(1), 1–9.

Matlák, J., Tihanyi, J. & Rácz, L. (2016). Relationship between reactive agility and change of direction speed in amateur soccer players. *J Strength Cond Res., 30*(6), 1547-1552. https://doi.org/https://doi.org/10.1519/JSC.0000000000001262

Oliver, J.L. & Harrison, C.B. (2020). Aerobic and anaerobic training for young athletes. In: Lloyd, RS & Oliver, JL (Eds), *Strength and conditioning for young athletes*.

Osgnach, C., Poser, S., Bernardini, R., Rinaldo, R. & Di Prampero, P.E. (2010). Energy Cost and Metabolic Power in Elite Soccer. *Medicine & Science in Sports & Exercise, 42*(1), 170–178. https://doi:10.1249/mss.0b013e3181ae5cfd

Schandl, G. (2018). A siker kulcsa az agilitás kognitív aspektusai. *Recreation*, *8*(3), 40-41.

Sheppard, J.M. & Young, W.B. (2006). Agility literature review. Classifications, training and testing. *Journal of Sports Science*, *24*(9), 919-932

Silva, H., Yuzo F.N., Beato M. & Marcelino R. (2022). Acceleration and deceleration demands during training sessions in football: a systematic review. *Science and Medicine in Football*, https://DOI: 10.1080/24733938.2022.2090600

Soós, I. (2022). Légző- és keringési rendszer, lokomotoros és mechanikai jellemzők vizsgálata, elsőosztályú 15 – 19 éves labdarúgó fiúk körében. PhD-értekezés. Pécsi Tudományegyetem.

Stølen, T., Chamari, K., Castagna, C. & Wisløff, U. (2005). Physiology of soccer: an update. *Sports Med, 35*(6), 501-36. https://doi: 10.2165/00007256-200535060-00004

Vass, Z. (2020). *Mozgásfejlődés, mozgástanulás, mozgástanítás – Elméleti alapok és módszertani megfontolások*. Budapest: Magyar Diáksport Szövetség.

Wehbe, G.M., Hartwig, T.B. & Duncan, C.S. (2014). Movement analysis of Australian national league soccer players using global positioning system technology. *J Strength Cond Res, 28*: 834–842.

Williams, A.M. & Reilly, T. (2000). Talent identification and development in soccer. *J Sport Sci, 18*(9), 657-67

Young, W.B., Rayner, R. & Talpey, S. (2021). It's Time to Change Direction on Agility Research. A Call to Action. *Sport Med – Open, 7*(12), https.//doi.org/10.1186/s40798-021-00304-y

Zurutuza, U., Castellano J., Echeazarra I., Guridi I. & Casamichana D. (2020). Selecting training-load measures to explain variability in football training games. *Front Psychol, 10*, 1–8. https://doi:10.3389/fpsyg.2019.02897

List of own funds

Publications on the topic of the doctoral thesis

<u>International publications</u>

1. **Gusztafik, Á.**, Halasi, S. & Koltai, M. (2022). Measuring Locomotor Training Performance with Mechanical Performance and Motoric Tests in the Case of Young Soccer Players. *TEM Journal: Technology, Education, Management, Informatics.* 11(4), 1846–1853. http://doi.org/10.18421/TEM114-52

2. Koltai, M., **Gusztafik, Á.**, Nagyváradi, K., Szeiler, B., Halasi, Sz., & Lepeš, J. (2020). The Connection Between the Agility of Adolescent Soccer Players and Their Body Composition. *Facta Universitatis Series: Physical Education and Sport.* 18(3),577-588. http://doi.org/10.22190/FUPES201111056K

3. **Gusztafik, Á.**, Halasi, S., Lepes, J., Nagyváradi, K., Szeiler, B. & Koltai, M. (2020). The connections between agility, endurance and motor skill tests in Serbian junior soccer players. Évkönyv – *Újvidéki Egyetem Magyar Tannyelvű Tanítóképző Kar* p. 10–23.

4. Koltai, M., **Gusztafik, Á.**, Nagyváradi, K., Szeiler, B., Halasi, Sz. & Ihász, F. (2017). Examination of agility factors of junior football players in Ba*č*ka Topola, Serbia. *SPARK: International Journal of Sport Science and Physical Education, 2(1),1-18.*

5. Koltai, M., Wallner, D., **Gusztafik, Ádám**, Sáfár, Z., Dancs, H., Simi, H., Hagenauer, M., & Buchgraber, A. M. (2022). Measuring of sport specific skills of football

players. *Journal of Human Sport and Exercise*, *11*(1proc), S218-S227. https://doi.org/10.14198/jhse.2016.11.Proc1.12

Hungarian publications

1. Koltai, M. & **Gusztafik, Á**. (2021). Mechanikai edzés-teljesítmény vizsgálata utánpótláskorú labdarúgóknál. *Magyar Sporttudományi Szemle*, *22*(1),26-33.

2. **Gusztafik, Á**. & Koltai, M. (2020). Állóképességi mutatók vizsgálata magyar és szerbiai utánpótláskorú labdarúgóknál. *Savaria Természettudományi és Sporttudományi Közlemények*, *18*, 107–116.

3. **Gusztafik, Á**. & Koltai, M. (2017). Az agilitás kérdései utánpótlás labdarúgók körében. In *Per Aspera ad Astra III: Válogatás a pszichológia, a sport, az egészségfejlesztés és a művészetek terén működő tudományos diákkörök hallgatóinak és oktatóinak közös munkáiból. ELTE PPK* (pp. 55–66).

International publications published in conference volumes

1. Koltai, M. & **Gusztafik, Á**. (2022). Relationship between Knee Strength, Change of Direction Speed and Leg Muscle Mass Among Elite Young Soccer Players. In *The 27th Annual Congress of the European College of Sport Science, Book of Abstract*, (602-602.p.)

2. Koltai, M. & **Gusztafik, Á**. (2021). Measuring Locomotor Training Perfomance and Yo-Yo IRTL1 Test in the Case of Young Soccer Players. In *ECSS Virtual Congress 2021* (pp.286-287).

3. **Gusztafik, Á**. & Koltai, M. (2021). Measuring Locomotor Training Perfomance with Mechanical Performance and Motoric Tests in the Case of Young Soccer Players. *In Abstracts from the 17th Annual Convention and International Conference of the International Network of Sport and Health Science: St.Petersburg, Russia*. 27–29 May 2021. (pp. 12–13).

4. Koltai, M. & **Gusztafik, Á**. (2020). Examination of Load Components Among the Young Soccer Players. *In 25th Annual Congress of the European College of Sport Science – Book of Abstracts* (pp.450-450).

5. **Gusztafik, Á**., Halasi, Sz., Nagyváradi, K., Szeiler, B. & Koltai, M. (2019). The connections between agility, endurance and motor skill tests in Serbian junior soccer players. In *12th International INSHS Christmas Sport Scientific Conference, Book of abstract* (p. 22).

Hungarian publications published in conference volumes

1. Koltai, M. & **Gusztafik, Á**. (2022). Az irányváltoztatási sebesség, a lábak sovány izomtömege és a láb dinamikus gyorserejének összefüggései fiatal élvonalbeli labdarúgóknál. *Magyar Sporttudományi Szemle*, *23*(2), 58.

2. **Gusztafik, Á**. & Koltai, M. (2021). Gyorsasági- és állóképességi futótesztek vizsgálata a testösszetétel, az erő- és az egyensúlyozási képesség tükrében utánpótláskorú labdarúgóknál. *Magyar Sporttudományi Szemle*, *22*(91), 57–58.

3. **Gusztafik, Á**. & Koltai, M. (2020). Mechanikai edzés-teljesítmény vizsgálata utánpótláskorú labdarúgóknál. *Magyar Sporttudományi Szemle*, *21*(3), 51–51.

4. **Gusztafik, Á**. (2019). Állóképességi mutatók vizsgálata utánpótláskorú labdarúgóknál. *XXXIV. Országos Tudományos Diákköri Konferencia Testnevelési- és Sporttudományi Szekció. Előadás-kivonatok* p. 25.

5. Koltai M., Nagyváradi, K., **Gusztafik, Á**., Szeiler, B. & Halasi, Sz. (2019). A testösszetétel és az agilitás összefüggéseinek vizsgálata utánpótlás korú labdarúgóknál. *Magyar Sporttudományi Szemle*, *20*(2), 70

6. **Gusztafik, Á**., Szeiler, B., Halasi, S. & Koltai, M. (2018). Állóképességi mutatók vizsgálata magyar és szerbiai utánpótláskorú labdarúgóknál. *Magyar Sporttudományi Szemle*, *19*(75), 44.

7. Szeiler, B., **Gusztafik, Á**., Halasi, Sz. & Koltai, M. (2018). Az agilitás és az állóképesség kapcsolata utánpótláskorú labdarúgóknál. *Magyar Sporttudományi Szemle*, *19*(75),83

8. **Gusztafik, Á**., Szeiler, B., Halasi, Sz. & Koltai, M. (2018). Állóképességi mutatók vizsgálata magyar és szerbiai utánpótláskorú labdarúgóknál.*19*(75), 44.

9. **Gusztafik, Á**. (2017). Koordinációs képességek hatása az agilitásra utánpótlás korú labdarúgóknál. *XXXIII. OTDK Testnevelés- és Sporttudományi Szekció. Rezümé kötet*, p.106.

10. **Gusztafik, Á**., Szűcs, I. & Koltai, M. (2017). Az agilitási- és a dinamikus egyensúlyozó képesség összehasonlító vizsgálata utánpótláskorú labdarúgóknál. *Magyar Sporttudományi Szemle*, *18*(70), 42–43.

11. Koltai, M., Nagyváradi, K., **Gusztafik, Á**., Szeiler, B. & Halasi, Sz. (2017). Utánpótláskorú labdarúgók teljesítményösszetevőinek vizsgálata. *Magyar Sporttudományi Szemle*, *18*(70), 53.

12. Nagyváradi, K., **Gusztafik, Á.**, Szeiler, B., Halasi, Sz., Koltai, M. (2017). Vajdasági labdarúgók testösszetétel vizsgálata. E-poszter. *Magyar Sporttudományi Szemle*, *18*(70), 64.

13. Szűcs, I., S. Nagy, Z., **Gusztafik, Á**. & Koltai, M. (2017). A statikus egyensúly fejlődésének kérdései. E-poszter, *Magyar Sporttudományi Szemle*, *18*(70), 82.

14. **Gusztafik, Á.**, Sáfár, Z. & Koltai, M. (2016). Az agilitás teljesítmény összetevőinek vizsgálata utánpótláskorú labdarúgóknál. *Magyar Sporttudományi Szemle*, *17*(68), 68–69.

15. **Gusztafik, Á**. (2015). A hátrafele futás szerepe a gyorsaság fejlesztésében. In *XXXII. Országos Tudományos Diákköri Konferencia Testnevelés- és Sporttudományi Szekció: program és összefoglalók* (pp. 85–85).

<u>International conference presentations</u>

1. Koltai, M. & **Gusztafik, Á**. (2022). Relationship between Knee Strength, Change of Direction Speed and Leg Muscle Mass Among Elite Young Soccer Players. *27th Annual Congress of the European College of Sport Science,* 31st August- 02nd September 2022, Sevilla, Spain.

2. **Gusztafik, Á**. & Koltai, M. (2021). Measuring Locomotor Training Perfomance with Mechanical Performance and Motoric Tests in the Case of Young Soccer Players. *17th Annual Convention and International Conference of the International Network of Sport and Health Science: St.Petersburg, Russia*. 27–29 May 2021.

3. Koltai, M. & **Gusztafik, Á**. (2021). Measuring Locomotor Training Perfomance and Yo-Yo IRTL1 Test in the Case of Young Soccer Players. European College of Sport Science (ECSS) Virtual Congress 8th-10th September, 2021.

4. Koltai, M. & **Gusztafik, Á**. (2020). Examination of Load Components Among the Young Soccer Players. *25th Annual Congress of the European College of Sport Science. Online* 28-30 October, 2020.

5. **Gusztafik, Á.**, Halasi., Sz., Nagyváradi., K., Szeiler B. & Koltai, M. (2019). The connections between agility, endurance and motor skill tests in Serbian junior soccer players. 12th International INSHS Christmas Sport Scientific Conference. 5th-6th of December, Szombathely,

6. **Gusztafik, Á**. & Koltai, M. (2019). The analysis of endurance variables among young soccer players. 8th International Perfomance Analysis Workshop and Conference.11th-13th September, Budapest.

7. Koltai, M. & **Gusztafik, Á**. (2019). Examination of agility factors of junior football players in Topola, Serbia.8th International Perfomance Analysis Workshop and Conference.11th-13th September, Budapest.

8. Koltai, M., Nagyváradi, K., **Gusztafik, Á**., Szeiler B. & Halasi, Sz. (2019). The analysis of links between young soccer players' body composition and agility. ECSS Prague, 03th-06th 2019.

9. Koltai, M., **Gusztafik, Á**., Nagyváradi, K., Szeiler, B., Halasi, Sz. & Ihász, F. (2017). Examination of agility factors of junior football players in *Bačka* Topola, Serbia. The 1st Euro-Pak International Conference on Sports Sciences and Physical Education 6th-8th October, 2017. Islamabad, Pakistan

10. **Gusztafik, Á**., Koltai, M., Wallner, D., Tóth, Zs., Sáfár, Z., Dancs, H., Simi, H., Hagenauer, M. & Buchgraber, A.M. (2015). Measuring of sport specific skills of football players. The 10th INSHS International Christmas Sport Scientific Conference. 2015, december 4-5. Szombathely.

Hungarian conference presentations

1. Koltai, M. & **Gusztafik, Á**. (2022). Az irányváltoztatási sebesség, a lábak sovány izomtömege és a láb dinamikus gyorserejének összefüggései fiatal élvonalbeli labdarúgóknál. XIX. Országos Sporttudományi Kongresszus, Szeged, 2022. Június 8-10.

2. **Gusztafik, Á**. & Koltai, M. (2021). Gyorsasági- és állóképességi futótesztek vizsgálata a testösszetétel, az erő- és az egyensúlyozási képesség tükrében utánpótláskorú labdarúgóknál. XVIII. Országos Sporttudományi Kongresszus, Pécs, 2021. Június 2-4.

3. **Gusztafik, Á**. & Koltai, M. (2020). Mechanikai edzés-teljesítmény vizsgálata utánpótláskorú labdarúgóknál. XVII. Országos Sporttudományi Kongresszus, Győr, 2020. Szeptember 2-4.

4. Koltai, M., Nagyváradi, K., **Gusztafik, Á**., Szeiler, B. & Halasi, Sz. (2019). A testösszetétel és az agilitás összefüggéseinek vizsgálata utánpótlás korú labdarúgóknál – előadás. XVI. Országos Sporttudományi Kongresszus, Nyíregyháza, 2019. Június 05-07.

5. **Gusztafik, Á**. (2019). Állóképességi mutatók vizsgálata utánpótláskorú labdarúgóknál. Országos Tudományos Diákköri Konferencia. Budapest, 2019. Március 28-30.

6. **Gusztafik, Á.**, Szeiler, B., Halasi, S. & Koltai, M. (2018). Állóképességi mutatók vizsgálata magyar és szerbiai utánpótláskorú labdarúgóknál. XV. Országos Sporttudományi Kongresszus. Szombathely, 2018.05.30-06.01.

7. Szeiler, B., **Gusztafik, Á.**, Halasi Sz. & Koltai, M. (2018). Az agilitás és az állóképesség kapcsolata motoros pályatesztekkel utánpótláskorú labdarúgóknál. XV. Országos Sporttudományi Kongresszus. Szombathely, 2018.05.30-06.01.

8. **Gusztafik, Á**. (2018). Állóképességi mutatók vizsgálata utánpótláskorú labdarúgóknál. Tudományos Diákköri Konferencia. Szombathely, 2018. November 21.

9. **Gusztafik, Á.**, Szeiler, B., Halasi, Sz., Nagyváradi, K. & Koltai, M. (2018). Állóképességi mutatók vizsgálata magyar és szerbiai utánpótláskorú labdarúgóknál. XV. Országos Sporttudományos Kongresszus. Szombathely, 2018. Május 30. - Június 1.

10. Szűcs, I., S. Nagy, Z., **Gusztafik, Á.** & Koltai, M. (2017). A statikus egyensúly fejlődésének kérdései. XIV. Országos Sporttudományos Kongresszus, Pécs, 2017. Június 1-3.

11. Koltai, M., Nagyváradi, K., **Gusztafik, Á.**, Szeiler, B. & Halasi, Sz. (2017). Nemzetközi kutatás a hallgatók bevonásával. Utánpótlás korú labdarúgók teljesítményösszetevőinek vizsgálata. XIV. Országos Sporttudományos Kongresszus. Pécs, 2017. Június 1-3.

12. Nagyváradi, K., **Gusztafik, Á.**, Szeiler, B. & Koltai, M. (2017). Szabadkai labdarúgók testösszetétel vizsgálata. XIV. Országos Sporttudományos Kongresszus. Pécs, 2017. Június 1-3.

13. **Gusztafik, Á.**, Szűcs, I. & Koltai, M. (2017). Az agilitási-és a dinamikus egyensúlyozó képesség összehasonlító vizsgálata utánpótláskorú labdarúgóknál. XIV. Országos Sporttudományos Kongresszus. Pécs, 2017. Június 1-3.

14. **Gusztafik, Á**. (2017). Koordinációs képességek hatása az agilitásra utánpótlás korú labdarúgóknál. Országos Tudományos Diákköri Konferencia. Győr, 2017. Március 23-25.

15. **Gusztafik, Á.**, Sáfár, Z. & Koltai, M. (2016). Az agilitás teljesítmény összetevőinek vizsgálata utánpótlás korú labdarúgóknál. Fiatal Sporttudósok IV. Országos Konferenciája. Budapest, 2016. December 3.

16. **Gusztafik**, **Á.** (2016). Koordinációs képességek hatása az agilitásra utánpótlás korú labdarúgóknál. Tudományos Diákköri Konferencia. Szombathely, 2016. November 29.

17. **Gusztafik, Á.,** Forsthoffer, T., Sáfár, Z. & Koltai, M. (2016). Gyorsasági és állóképességi mutatók vizsgálata egy elit képzéssel foglalkozó labdarúgó akadémián. XIII. Országos Sporttudományi Kongresszus. Szombathely, 2016. Május 26-28.

18. **Gusztafik, Á**. & Németh, N. (2015). Labdarúgó játékosok hosszú távú passzolási pontosságának és cselezési készségének vizsgálata egy nemzetközi kutatás keretében. Hallgatói konferencia. Szombathely, 2015. December 2.

19. **Gusztafik, Á.** (2015). A hátrafele futás szerepe a gyorsaság fejlesztésében. Országos Tudományos Diákköri Konferencia. Pécs, 2015. Április 8-10.

20. **Gusztafik, Á**. (2014). A hátrafele futás szerepe a gyorsaság fejlesztésében. Tudományos Diákköri Konferencia. Szombathely, 2014.11.25.

Publications outside the topic of the doctoral thesis

1. **Gusztafik, Á**. & Koltai, M. (2023). Az ügyesség (változó) helye és szerepe a motoros képességek rendszerében. Az ügyességfejlesztés időszerű kérdései. *Magyar Sporttudományi Szemle*, bírálat alatt.