



## The impact of physical fitness, cognitive ability, and age on soccer playing skills in young players

*El impacto de la forma física, la capacidad cognitiva y la edad en las habilidades de juego en futbolistas jóvenes*

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### Abstract

**Introduction:** Physical fitness and cognitive ability are two important components in football playing performance, especially in the young age group.

**Objective:** This study aims to analyze the effect of VO<sub>2</sub>max, IQ, and age on football playing skills in young players.

**Methodology:** This study used a cross-sectional design involving 66 players aged 13, 15, and 17 years from various clubs in Palembang. VO<sub>2</sub>max was measured through the Bleep Test, IQ through a standard intelligence test, and playing skills through the David Lee football skills test. The analysis was carried out using the Spearman correlation test.

**Discussion:** The results showed a significant positive correlation between VO<sub>2</sub>max, IQ, and age on football playing skills ( $p < 0.01$ ). Age showed the highest correlation with playing skills ( $r = 0.824$ ), followed by IQ ( $r = 0.798$ ) and VO<sub>2</sub>max ( $r = 0.750$ ).

**Conclusions:** This study has shown that physical fitness, cognitive ability, and age have a significant influence on soccer playing skills in young players. The positive relationship between the three variables indicates that the development of playing skills cannot be separated from the interaction between physical readiness, cognitive capacity, and age maturity. This study has succeeded in meeting its objectives by proving that age is a dominant predictor, while physical fitness and IQ provide significant contributions simultaneously to improving technical performance. Thus, the development of age-based training programs that integrate physical and cognitive aspects is highly recommended to maximize the potential of young players in the game of soccer.

### Keywords

Physical Fitness; cognitive ability; age; football skills.

### Resumen

**Introducción:** La forma física y la capacidad cognitiva son dos componentes importantes en el rendimiento en la práctica del fútbol, especialmente en el grupo de edad joven.

**Objetivo:** Este estudio tiene como objetivo analizar el efecto del VO<sub>2</sub>max, el coeficiente intelectual y la edad en las habilidades de juego de fútbol en jugadores jóvenes.

**Metodología:** Este estudio utilizó un diseño transversal en el que participaron 66 jugadores de 13, 15 y 17 años de varios clubes de Palembang. El VO<sub>2</sub>max se midió mediante el test Bleep, el CI mediante un test de inteligencia estándar y las habilidades de juego mediante el test de habilidades futbolísticas David Lee. El análisis se llevó a cabo mediante la prueba de correlación de Spearman.

**Discusión:** Los resultados mostraron una correlación positiva significativa entre el VO<sub>2</sub>max, el CI y la edad en las habilidades de juego de fútbol ( $p < 0,01$ ). La edad mostró la mayor correlación con las habilidades de juego ( $r = 0,824$ ), seguida del CI ( $r = 0,798$ ) y el VO<sub>2</sub>max ( $r = 0,750$ ).

**Conclusiones:** Este estudio ha demostrado que la condición física, la capacidad cognitiva y la edad tienen una influencia significativa en las habilidades de juego de fútbol en jugadores jóvenes. La relación positiva entre las tres variables indica que el desarrollo de las habilidades de juego no puede separarse de la interacción entre la preparación física, la capacidad cognitiva y la madurez de la edad. Este estudio ha logrado cumplir sus objetivos al demostrar que la edad es un factor predictivo dominante, mientras que la preparación física y el coeficiente intelectual contribuyen de forma significativa y simultánea a la mejora del rendimiento técnico. Por lo tanto, el desarrollo de programas de entrenamiento basados en la edad que integren aspectos físicos y cognitivos es muy recomendable para maximizar el potencial de los jugadores jóvenes en el juego del fútbol.

### Palabras clave

Aptitud Física; capacidad cognitiva; edad; habilidades futbolísticas.

## Introduction

Soccer is a sport that combines physical and cognitive factors in a complex way, where physical abilities such as speed, strength, and endurance are instrumental in supporting players' performance on the field, while cognitive skills such as decision-making, tactical understanding, and game intelligence determine success in dynamic match situations (Abarghoueinejad et al. 2021). Cognitive and physical play a very important role in the game of football, where fast and precise decision-making skills, supported by cognitive abilities, interact directly with players' physical conditions, such as sprint speed, endurance, and agility, to achieve optimal performance on the field (Kelly et al. 2021).

Both physical and cognitive aspects play an important role in football performance, with physical activity levels maintained during COVID-19 quarantine contributing to faster physical recovery, while cognitive abilities to manage stress and make quick decisions influence player performance once competition resumes (Slaidiņš & Fernāte. 2021). Football-specific cognitive skills, such as decision-making, have a more significant role in differentiating the level of play of young players compared to general cognitive skills, although they are interrelated (Martin et al. 2025). Motor coordination skills such as adaptability and complex reaction time play an important role in improving the effectiveness of football players, where adaptability supports attack and comprehensive play, while complex reaction time has more influence on defensive effectiveness (Bojkowski et al. 2022).

Development in football involves various interconnected aspects, such as physical fitness, cognitive ability, and player age. One factor that affects physical fitness is VO<sub>2</sub>max, which is a measure of the body's capacity to use oxygen during high-intensity physical activity (Pranata et al. 2024). Development of VO<sub>2</sub> max through structured training methods can contribute greatly to improving the physical fitness of adolescent athletes (Jatmiko et al. 2024). Interval training can improve the performance of young players (Ortiz-pulido et al. 2022). In addition, football players' IQ is positively related to their performance on the pitch, where higher cognitive abilities allow players to make faster and more informed decisions, which in turn improve their game effectiveness (Nakisa & Rahbardar 2021). IQ plays an important role in the game of football, where players with higher levels of intelligence tend to be faster at making strategic decisions, reading game situations, and anticipating opponents' moves, which contributes to their improved performance on the pitch (McNamara 2023).

The age of football players is also a significant factor in skill development. At a young age, players tend to be at the stage of learning basic skills, while at a more mature age, technical skills and game strategies begin to develop better (Benítez-Sillero et al. 2021). Therefore, it is important to understand how physical fitness, cognitive ability, and age influence each other in shaping football playing skills in young players.

This study aims to analyse the impact of physical fitness measured through VO<sub>2</sub>max, cognitive ability measured through IQ, and age on the football playing skills of young players. In this context, understanding the relationship between these three factors can provide valuable insights for the training and development of young football players, as well as help improve the effectiveness of training programmes implemented by coaches.

## Method

### Research Design

This study used a cross-sectional design to evaluate the relationship between VO<sub>2</sub>max, IQ, age, and football playing skills in Palembang city. The study was conducted over three months, from December 2024 to February 2025.





significance value is significant  $> 0.05$ , then the data is normally distributed; but if the significance value is  $< 0.05$ , then the data is not normally distributed and normally distributed. Then, if the data is normally distributed, the analysis can proceed with the Pearson correlation test. However, if the data is not normally distributed, the Spearman correlation test (a non-parametric test) is used instead. The correlation test was used to test the relationship between VO<sub>2</sub> Max, player IQ, age, and football playing skills. The significance level was set at  $p < 0.05$ .

## Results

### Participant Characteristics

The average age of the participants was  $15.0 \pm 1.6$  years, the average cognitive ability (IQ) was  $101.8 \pm 18.3$ , the average football playing skill (FPS) was  $21.9 \pm 3.1$  seconds, and the average physical fitness (VO<sub>2</sub> max) was  $48.0 \pm 3.2$  ml/kg/min.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
VO <sub>2</sub> Max	66	42.30	54.10	47.9727	3.19733
IQ	66	75	130	101.83	18.288
Age	66	13	17	15.00	1.646
FPS	66	16.23	27.48	21.9067	3.08284

Furthermore, the results of the research data were tested for normality using the Kolmogorov-Smirnov normality test to determine whether the data were normally distributed or not. The results of the Kolmogorov-Smirnov normality test are presented in Table 3. Based on the data in Table 3, it can be concluded that the data is not normally distributed, this is based on the Sig value, which shown by the Sig value. (2-tailed)  $< 0.05$ , only one variable has a Sig value. (2-tailed)  $> 0.05$ , namely the VO<sub>2</sub> Max variable with a Sig value. (2-tailed) 0.200. Based on the results of this Normality Test, further testing uses the Spearman correlation test (nonparametric) to analyse the relationship between several variables, namely VO<sub>2</sub> Max, player IQ, age, and football playing skills. The results of the Spearman correlation analysis are presented in Table 4.

Table 3. One-Sample Kolmogorov-Smirnov Test

	N	VO <sub>2</sub> Max	IQ	Age	FPS
		66	66	66	66
Normal Parameters	Mean	47.9727	101.83	15.00	21.9067
	Std. Deviation	3.19733	18.288	1.646	3.08284
Most Extreme Differences	Absolute	.071	.226	.221	.110
	Positive	.071	.226	.221	.074
	Negative	-.054	-.127	-.221	-.110
Test Statistic		.071	.226	.221	.110
Asymp. Sig. (2-tailed)		.200	.000	.000	.045

Table 4. Correlations Spearman's

		VO <sub>2</sub> Max	IQ	Age	FPS
VO <sub>2</sub> Max	Correlation Coefficient	1.000	.822**	.702**	.750**
	Sig. (2-tailed)	.	.000	.000	.000
	N	66	66	66	66
IQ	Correlation Coefficient	.822**	1.000	.731**	.798**
	Sig. (2-tailed)	.000	.	.000	.000
	N	66	66	66	66
Age	Correlation Coefficient	.702**	.731**	1.000	.824**
	Sig. (2-tailed)	.000	.000	.	.000
	N	66	66	66	66
FPS	Correlation Coefficient	.750**	.798**	.824**	1.000
	Sig. (2-tailed)	.000	.000	.000	.
	N	66	66	66	66

\*\* Correlation is significant at the 0.01 level (2-tailed).

## Discussion

### ***Correlation of Physical Fitness and Cognitive Ability***

The results showed a significant positive correlation between Physical Fitness and Cognitive Ability ( $r = 0.882$ ,  $p = 0.000$ ). In this case, physical fitness is seen from VO2 Max results, and cognitive abilities from IQ. This finding shows that the higher the level of physical fitness of a player, the better his cognitive abilities tend to be. This reflects that good physical condition is related to concentration, focus, and grasp of game tactics. Improved physical fitness accompanied by cognitive stimulation can strengthen brain functions, including concentration, information processing speed, and decision-making in complex match situations. Thus, excellent physical condition not only supports stamina but also has a direct positive impact on players' mental readiness to deal with high levels of game pressure (Staiano et al. 2022). Physical fitness developed through a brain endurance training approach also strengthens cognitive resilience, which is crucial in sports such as football, where players need to stay focused, make quick decisions, and adjust to game dynamics simultaneously (Dallaway et al. 2021). Training that combines physical activity with cognitive challenges can simultaneously improve physical endurance as well as executive brain functions, such as attention, mental resilience, and decision-making (Staiano et al. 2023). High levels of physical fitness help minimise fatigue accumulation and maintain stable cognitive performance throughout the match. Therefore, the maintenance of physical fitness is not only important for the stamina aspect, but it is also a key foundation in maintaining players' mental readiness at the highest competitive level (Angius et al. 2022).

### ***Correlation between Physical Fitness and Age***

The results showed a significant positive correlation between Physical Fitness and age ( $r = 0.702$ ,  $p = 0.000$ ). This finding shows that age is directly proportional to physical fitness in this group, namely the older the age, the better the physical fitness of a football player. This is due to an increase in exercise capacity as age increases (in the teenage age range). As the adolescent group ages, there is a significant increase in physical fitness components such as strength, speed and endurance. These improvements are closely related to the increased frequency and intensity of training that the body can tolerate, as well as more mature physiological adaptations to training loads. Thus, age is one of the factors that influence the progress of physical fitness in young players, especially when accompanied by a structured and continuous training programme (Castro-Infantes et al. 2024). players with a relatively higher age have superior physical performance, especially in aspects of endurance and speed, which are strongly thought to be related to the body's adaptation to training and biological maturity. This indicates that with increasing age, especially in the adolescent age range, the physical fitness ability of football players tends to increase as a result of increased training capacity, playing experience, and physiological development that supports sports performance (Bonilla et al. 2024). Increasing age in the adolescent to early adult range allows players to develop optimal physical fitness capacity through increased training intensity and better tactical understanding (Vacarro Benet et al. 2024). As age increases in adolescence, the body's ability to adjust to training loads increases, which in turn promotes the development of overall physical quality. Thus, age is one of the key elements that support the growth of physical fitness in young football players (Bujnovsky et al. 2019)

### ***Correlation of Physical Fitness and Football Playing Skills***

The results showed a significant positive correlation between Physical Fitness and Football Playing Skills ( $r = 0.750$ ,  $p = 0.000$ ). This finding shows that players who have high physical fitness tend to show better playing skills. Sprinting ability, stamina, and strength support technical performance on the field. Sprinting ability, stamina and strength support technical performance on the pitch. Technical and tactical performance on the field is strongly influenced by a player's physical capacity, especially in supporting transition speed, duel success, and effectiveness in defending and building attacks (Mason et al. 2024). Improved physical fitness not only contributes to basic movement abilities, but also supports improved technical skills in play. Players who have better physical fitness tend to show superior technical performance on the field, both in terms of ball possession, passing accuracy, and response to overall game situations (Aksoy and Saygın 2020). This improvement in physical ability has a direct impact on the quality of playing skills, especially in tactical decision-making, response to game pressure, and efficiency in performing technical movements such as dribbling and passing (Nikolaienko and Vorobiov



2023). Good physical fitness not only improves motor performance, but also strengthens the execution of tactical aspects of the game, which in turn has an impact on improving overall playing skills (Figueira et al. 2018). Players with higher levels of physical fitness have better motor efficiency, such as movement speed, coordination, and agility that make football players more skilled in performing playing techniques in a match (Matos et al. 2023).

### ***Correlation of Cognitive Ability and Age***

The results showed a significant positive correlation between Cognitive Ability and Age ( $r = 0.731$ ,  $p = 0.000$ ). This finding shows that as we get older, cognitive ability increases sharply, including understanding tactics, reading the game, and decision making. The decision-making process in team sports is strongly influenced by cognitive development that occurs with the accumulation of experience and increased exposure to complex game situations. Players who are more mature in age tend to have a better ability to recognise patterns of play, anticipate opponents' actions, and choose the most effective response within a limited time (Ashford et al. 2021). The decision-making process in young athletes develops with age and playing experience. Older players in the young age category show higher cognitive performance because they have experienced more game situations, received feedback from coaches, and engaged in exercises that stimulate aspects of pattern recognition and strategic responses (Silva et al. 2020). Football players who have a more mature age contribute to maturity in understanding the dynamics of the game and in making the right and fast decisions on the field (Zhao et al. 2022). The older players in the young age category show higher cognitive performance than younger players, especially in playing positions that demand fast and accurate decision making (Schumacher et al. 2018).

### ***Correlation of Cognitive Ability and Football Playing Skills***

The results showed a significant positive correlation between Cognitive Ability and Football Playing Skills ( $r = 0.798$ ,  $p = 0.000$ ). This finding shows that players who are cognitively more intelligent also show higher football playing skills, such as positioning, intelligent passing, and anticipation of opponent movements. Players with better executive function are able to make faster decisions, adjust strategies in changing game situations, and process multiple information simultaneously under pressure. Cognitive intelligence not only supports mental aspects, but also has a direct impact on the quality of football playing skills on the field (Lervold and Kaalvik 2025). High cognitive intelligence in football players directly contributes to improved playing skills, such as effective positioning, intelligent passing, and the ability to anticipate opponents' movements (Jakobsen 2020). High cognitive intelligence contributes to the improvement of the technical and tactical aspects of the game, which include precise positioning, accurate passing ability, and quick reactions to changing situations on the pitch (Scharfen 2022).

### ***Age Correlation with Football Playing Skills***

The results showed a significant positive correlation between age and Football Playing Skills ( $r = 0.824$ ,  $p = 0.000$ ). This finding suggests that as players get older (within the data range), their playing skills improve. This could be due to a combination of experience, repeated practice, and mental development. Long-term playing experience contributes to the strengthening of certain cognitive aspects during active play, especially in the context of information processing and strategic decision-making on the field (Macnab et al. 2023). The process of tactical skill development in young players is strongly influenced by playing experience, the frequency of repeated practice, as well as cognitive maturity that increases with age (Machado et al. 2020). Older age in the data range is associated with improved playing skills, as players have gone through an intensive training phase, played in a competitive context, and experienced deep mental development (Machado et al. 2023). With increasing age, players tend to be better able to assimilate complex tactical information and apply it in real game contexts (Gaviria Alzate et al. 2024). Increasing age in the developmental span not only reflects the accumulation of experience, but also leads to the internalisation of deep tactical knowledge and cognitive efficiency that support the improvement of overall playing skills (Cardoso et al. 2019).



## Conclusions

This study has shown that physical fitness, cognitive ability, and age have a significant influence on soccer playing skills in young players. The positive relationship between the three variables indicates that the development of playing skills cannot be separated from the interaction between physical readiness, cognitive capacity, and age maturity. This study has succeeded in meeting its objectives by proving that age is a dominant predictor, while physical fitness and IQ provide significant contributions simultaneously to improving technical performance.

The main contribution of this study lies in its integrative approach in examining multidimensional factors that influence playing skills, thus broadening the understanding of the dynamics of young player development in the context of soccer. In addition, the results of this study provide an empirical basis for designing training programs that not only emphasize physical aspects, but also cognitive stimulation that is appropriate to the developmental phase of young athletes' ages.

In the future, this study can be used as a reference in the development of age-based training curricula and cognitive functions, as well as encouraging further exploration of integrated training interventions that combine physical and mental training to support the optimization of player performance as a whole.

## References

- Abarghoueinejad, Maryam, Daniel Barreira, Cláudia Dias, Eduardo Guimarães, Adam D.G. Baxter-Jones, and José Maia. 2021. "Body Physique, Body Composition, Physical Performance, Technical and Tactical Skills, Psychological Development, and Club Characteristics of Young Male Portuguese Soccer Players: The Inex Study." *International Journal of Environmental Research and Public Health* 18 (7). <https://doi.org/10.3390/ijerph18073560>.
- Aksoy, Ömer, and Özcan Saygın. 2020. "Investigation of the Effects of 8-Week Football Training on Fine Motor Skills and Selected Physical Fitness Elements in 11-13 Years Old Children Group." *European Journal of Physical Education and Sport Science* 6: 60. <https://doi.org/10.46827/ejpe.v6i6.3256>.
- Angius et al. 2022. "Physical and Mental Fatigue Reduce Psychomotor Vigilance in Professional Football Players." *International Journal of Sports Physiology and Performance* 17 (9): 1391–98. <https://doi.org/https://doi.org/10.1123/ijsp.2021-0387>.
- Ashford, Michael, Andrew Abraham, and Jamie Poolton. 2021. "Understanding a Player's Decision-Making Process in Team Sports: A Systematic Review of Empirical Evidence." *Sports* 9 (5): 1–28. <https://doi.org/10.3390/SPORTS9050065>.
- Benítez-Sillero, Juan De Dios, Luis Manuel Martínez-Aranda, Manuel Sanz-Matesanz, and Marta Domínguez-Escribano. 2021. "Determining Factors of Psychological Performance and Differences among Age Categories in Youth Football Players." *Sustainability (Switzerland)* 13 (14): 1–10. <https://doi.org/10.3390/su13147713>.
- Bojkowski, Łukasz, Paweł Kalinowski, Robert Śliwowski, and Maciej Tomczak. 2022. "The Importance of Selected Coordination Motor Skills for an Individual Football Player's Effectiveness in a Game." *International Journal of Environmental Research and Public Health* 19 (2). <https://doi.org/10.3390/ijerph19020728>.
- Bonilla, Montenegro, A D ; Rodríguez, Aura D Montenegro Bonilla, Sergio D Rodríguez, Víctor Hernández-Beltrán, José M Gamonales, Markel Rico-González, et al. 2024. "Citation: Comparative Analysis of the Physical, Tactical, Emotional, and Mood Characteristics of Under-13 Soccer Players by Performance Level." *J. Funct. Morphol. Kinesiol* 2024: 237. <https://doi.org/10.3390/jfmk9040237>.
- Bujnovsky, David, Tomas Maly, Kevin R. Ford, Dai Sugimoto, Egon Kunzmann, Mikulas Hank, and Frantisek Zahalka. 2019. "Erratum to: Bujnovsky, d., et Al. Physical Fitness Characteristics of High-Level Youth Football Players: Influence of Playing Position. *Sports* 2019, 7, 46." *Sports* 7 (12): 7120250. <https://doi.org/10.3390/sports7120250>.
- Cardoso, Felipe da S.L., Sixto González-Víllora, José Guilherme, and Israel Teoldo. 2019. "Young Soccer Players With Higher Tactical Knowledge Display Lower Cognitive Effort." *Perceptual and Motor Skills* 126 (3): 499–514. <https://doi.org/10.1177/0031512519826437>.



- Castro-Infantes, Santiago, Víctor M. Soto Hermoso, Ricardo Martín-Moya, Filipe Manuel Clemente, Hugo Sarmiento, Alfonso Castillo-Rodríguez, and Francisco Tomás González-Fernández. 2024. "Principal Component Approach and Relationship between Nomination Scale for Identification of Football Talent and Physical Fitness in Young Soccer Players." *Applied Sciences (Switzerland)* 14 (17). <https://doi.org/10.3390/app14177569>.
- Dallaway, Neil, Samuel J.E. Lucas, and Christopher Ring. 2021. "Concurrent Brain Endurance Training Improves Endurance Exercise Performance." *Journal of Science and Medicine in Sport* 24 (4): 405–11. <https://doi.org/10.1016/j.jsams.2020.10.008>.
- Figueira, Bruno, Bruno Gonçalves, Nerijus Masiulis, and Jaime Sampaio. 2018. "Exploring How Playing Football with Different Age Groups Affects Tactical Behaviour and Physical Performance." *Biology of Sport* 35 (2): 145–53. <https://doi.org/10.5114/biolsport.2018.71603>.
- Gaviria Alzate, Samuel Jose, Wilder Geovanny Valencia-Sánchez, Frank Esteban Espinal, Jorge Luis Bustamante, and Elkin Arias-Arias. 2024. "Tactical Critical Thinking Program on the Tactical Efficiency Index, Declarative and Procedural Knowledge in Male Soccer Players: A Case Study." *Frontiers in Sports and Active Living* 6 (December): 1–15. <https://doi.org/10.3389/fspor.2024.1469347>.
- Irianto, S. 2011. "Standardisasi Kecakapan Bermain Sepakbola Untuk Siswa Sekolah Sepakbola (Ssb) Ku 14-15 Tahun Se-Daerah Istimewa Yogyakarta." *Jurnal Olahraga Prestasi* 7 (7): 44–50.
- Jakobsen, Douglas. 2020. "Intelligence in Football: Conceptualizations , Developmental Methodologies and Behaviors." *Gymnastik- Och Idrottshögskolan (GIH)*. <http://gih.diva-portal.org/smash/record.jsf?pid=diva2%3A1395164&dsid=-5644>.
- Jatmiko, Tutur, Nining Widyah Kusnanik, Nurhasan Nurhasan, Heryanto Nur Muhammad, and Septyaningrum Putri Purwoto. 2024. "Increase of VO2 Max After 8 Weeks Tuja Shuttle Run Exercise for Athletes in the 14-17 Year Age Group." *Retos* 55: 575–80. <https://doi.org/10.47197/retos.v55.103973>.
- Kelly, Adam L., Mark R. Wilson, Daniel T. Jackson, Jennifer Turnidge, and Craig A. Williams. 2021. "Speed of Thought and Speed of Feet: Examining Perceptual-Cognitive Expertise and Physical Performance in an English Football Academy." *Journal of Science in Sport and Exercise* 3 (1): 88–97. <https://doi.org/10.1007/s42978-020-00081-2>.
- Lervold, Kathrine, and Hilde Kaalvik. 2025. "A Scoping Review of Empirical Research on Executive Functions and Game Intelligence in Soccer," no. March. <https://doi.org/10.3389/fpsyg.2025.1536174>.
- Machado, G., González-Víllora, S., & Teoldo, I. 2023. "The Relationship between Deliberate Practice, Play, and Futsal in Childhood and Adolescence and the Development of Different Decision-Making Skills in Professional Female Soccer Players." *Psychology of Sport and Exercise* 68: 102470. <https://doi.org/https://doi.org/10.1016/j.psychsport.2023.102470>.
- Machado, Guilherme, Sixto González-Víllora, Hugo Sarmiento, and Israel Teoldo. 2020. "Development of Tactical Decision-Making Skills in Youth Soccer Players: Macro- and Microstructure of Soccer Developmental Activities as a Discriminant of Different Skill Levels." *International Journal of Performance Analysis in Sport* 20 (6): 1072–91. <https://doi.org/10.1080/24748668.2020.1829368>.
- Macnab, Tara Mei Povall, Shima Espahbodi, Eef Hogervorst, Ahmed Thanoon, Gwen Sascha Fernandes, Bonnie Millar, Ashley Duncan, et al. 2023. "Cognitive Impairment and Self-Reported Dementia in UK Retired Professional Soccer Players: A Cross Sectional Comparative Study." *Sports Medicine - Open* 9 (1). <https://doi.org/10.1186/s40798-023-00588-2>.
- Martin L. Reinhard, David L. Mann, Oliver Höner. 2025. "The Role of Generic Cognitive Skills: An Empirical Investigation into the Association between Generic and Sport-Specific Cognitive Skills and Playing Level in Youth Football." *Journal of Science and Medicine in Sport*, 1–25. <https://doi.org/10.1016/j.jsams.2025.01.010>.
- Mason L, Panayi S, Wright J, Bruce-Low S. 2024. "The Association between Physical Outputs and Match Outcome across Different Playing Styles for a Professional Second-Tier Football Team across Two Complete Seasons." *J Sports Med Phys Fitness* 64 (12): 1241–49. <https://doi.org/Doi:10.23736/S0022-4707.24.15806-9>.
- Matos, Rui, Carlos Moreira, Emília Alves, José Eduardo Teixeira, Filipe Rodrigues, Diogo Monteiro, Raul Antunes, and Pedro Forte. 2023. "Tactical Knowledge by Decision Making and Motor Efficiency

- of Young Football Players in Different Playing Positions during a Three-a-Side Small-Sided Game.” *Behavioral Sciences* 13 (4). <https://doi.org/10.3390/bs13040310>.
- McNamara, E. L. 2023. “Football IQ: Technical Report.” National College of Ireland.
- Nakisa, Nima, and Mahboobeh Ghasemzadeh Rahbardar. 2021. “Comparison of IQ, EI, Sports Performance, and Psychological Characteristics of Young Male Soccer Players in Different Playing Positions.” *Annals of Applied Sport Science* 9 (1): 1–8. <https://doi.org/10.29252/aassjournal.910>.
- Nikolaienko, V. V., and M. I. Vorobiov. 2023. “Aspects of Technical and Tactical Training of Young Football Players.” *Scientific Journal of National Pedagogical Dragomanov University. Series 15. Scientific and Pedagogical Problems of Physical Culture (Physical Culture and Sports)* 4 (4(163)): 12–17. [https://doi.org/10.31392/npu-nc.series15.2023.04\(163\).02](https://doi.org/10.31392/npu-nc.series15.2023.04(163).02).
- Nini, D., Anang, L. 2012. *Psikologi Pembelajaran*. Yogyakarta: Mentari Pustaka.
- Ortiz-pulido, Ricardo, Rubén Ortiz-pulido, Julio Alejandro Gómez-figueroa, and Raúl Ortiz-pulido. 2022. “Efecto Del Entrenamiento de Intervalo En Jugadores Mexicanos Juveniles de Fútbol Soccer.” *Retos* 2041: 907–17. <https://doi.org/https://doi.org/10.47197/retos.v44i0.89997>.
- Pranata, Didi Yudha, Furqon Hidayatullah, Sulaiman, Sri Sumartiningsih, Harry Pramono, and Heny Setiawaty. 2024. “Health and Fitness Study of Semarang Soccer Players: The Role of VO2 Max, Body Mass Index, Age and Length of Training.” *Retos* 61: 400–404. <https://doi.org/10.47197/retos.v61.108184>.
- Scharfen, H E. 2022. “The Relationship of Cognitive Functions with Physical Skills, Game Intelligence, Game Time and Its Training in Elite Soccer Players.” *Fis.Dshs-Koeln.De*, no. January. [https://fis.dshs-koeln.de/portal/files/6761866/Dissertation\\_final.pdf](https://fis.dshs-koeln.de/portal/files/6761866/Dissertation_final.pdf).
- Schumacher, Nils, Mike Schmidt, Kai Wellmann, and Klaus Michael Braumann. 2018. “General Perceptual-Cognitive Abilities: Age and Position in Soccer.” *PLoS ONE* 13 (8): 1–17. <https://doi.org/10.1371/journal.pone.0202627>.
- Silva, Ana Filipa, Daniele Conte, and Filipe Manuel Clemente. 2020. “Decision-Making in Youth Team-Sports Players: A Systematic Review.” *International Journal of Environmental Research and Public Health* 17 (11): 1–23. <https://doi.org/10.3390/ijerph17113803>.
- Slaidiņš, Kristaps, and Andra Fernāte. 2021. “IMPACT OF PHYSICAL ACTIVITY LEVELS OF ALGERIAN FOOTBALL PLAYERS DURING CONFINEMENT ( COVID19 ) ON THE PHYSICAL PERFORMANCE ONCE THE RES .... FLASE JOURNAL OF SPORT SCIENCE Is a Scientific Journal Published Two Times per Year in Sport Science LASE Journal.” *LASE Journal Of Sport Science*, no. May 2022. <https://doi.org/10.2478/ljss-2018-004>.
- Staiano, Walter, Samuele Marcora, Marco Romagnoli, Ulrich Kirk, and Christopher Ring. 2023. “Brain Endurance Training Improves Endurance and Cognitive Performance in Road Cyclists.” *Journal of Science and Medicine in Sport* 26 (7): 375–85. <https://doi.org/10.1016/j.jsams.2023.05.008>.
- Staiano, Walter, Michele Merlini, Marco Romagnoli, Ulrich Kirk, Christopher Ring, and Samuele Marcora. 2022. “Brain Endurance Training Improves Physical, Cognitive, and Multitasking Performance in Professional Football Players.” *International Journal of Sports Physiology and Performance* 17 (12): 1732–40. <https://doi.org/10.1123/ijsp.2022-0144>.
- Vaccaro Benet, Pau, Alexis Ugalde-Ramírez, Carlos D. Gómez-Carmona, José Pino-Ortega, and Boryi A. Becerra-Patiño. 2024. “Identification of Game Periods and Playing Position Activity Profiles in Elite-Level Beach Soccer Players Through Principal Component Analysis.” *Sensors* 24 (23): 1–13. <https://doi.org/10.3390/s24237708>.
- Zhao, Jie, Qian Gu, Shuo Zhao, and Jie Mao. 2022. “Effects of Video-Based Training on Anticipation and Decision-Making in Football Players: A Systematic Review.” *Frontiers in Human Neuroscience* 16 (November). <https://doi.org/10.3389/fnhum.2022.945067>.

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