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Original

Patrones predominantes de control cerebral entre los profesionales de la natación y sus familias Preparación de los estudiantes

Prevailing Patterns of Brain Control among Swimming Practitioners and Their Families Student Preparation

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PATRONES PREDOMINANTES DE DOMINANCIA CEREBRAL ENTRE JÓVENES NADADORES DE COMPETICIÓN Y SUS PADRES: UN ESTUDIO DESCRIPTIVO CORRELACIONAL

RESUMEN

Antecedentes: La dominancia cerebral representa una característica cognitiva importante que puede influir en el aprendizaje motor, la toma de decisiones y el rendimiento deportivo. Investigar los patrones de dominancia cerebral entre jóvenes nadadores de competición y sus padres puede proporcionar información valiosa sobre los perfiles cognitivos asociados a la participación deportiva y las influencias familiares. Objetivo: Este estudio tuvo como objetivo identificar los patrones de dominancia cerebral predominantes entre jóvenes nadadores de competición y sus padres, y examinar la relación entre los patrones de dominancia cerebral de los nadadores y los de sus padres. Métodos: Se empleó un diseño descriptivo correlacional. El estudio incluyó a 50 jóvenes nadadores de competición inscritos en la Federación Jordana de Natación del Club Al-Hassan City y a un progenitor por cada nadador. Los participantes fueron seleccionados mediante muestreo intencional. La dominancia cerebral se evaluó utilizando la Escala de Dominancia Cerebral de Diane (2005), que fue traducida y adaptada culturalmente al árabe. El instrumento demostró una excelente consistencia interna (alfa de Cronbach = 0,981). Se utilizaron estadísticas descriptivas y el coeficiente de correlación de Pearson para analizar los datos. Resultados: El patrón de dominancia cerebral integrada fue el más frecuente tanto en jóvenes nadadores de competición como en sus padres. Además, se encontró una fuerte correlación positiva entre los patrones de dominancia cerebral de los nadadores y los de sus padres ($r = 0,812$, $p < 0,001$). Conclusión: Los hallazgos indican que tanto los jóvenes nadadores de competición como sus padres presentan predominantemente un patrón de dominancia cerebral integrada. La asociación positiva significativa entre los nadadores y sus padres sugiere que las características cognitivas familiares podrían estar relacionadas con el desarrollo de perfiles de dominancia cerebral similares. Se recomiendan estudios futuros con muestras más amplias y diversas para investigar más a fondo esta relación.

Palabras clave: Dominancia cerebral; Jóvenes nadadores de competición; Padres; Características cognitivas; Aprendizaje motor; Psicología del deporte.

PREVAILING BRAIN DOMINANCE PATTERNS AMONG YOUNG COMPETITIVE SWIMMERS AND THEIR PARENTS: A DESCRIPTIVE CORRELATIONAL STUDY

ABSTRACT

Background: Brain dominance represents an important cognitive characteristic that may influence motor learning, decision-making, and athletic performance. Investigating brain dominance patterns among young competitive swimmers and their parents may provide valuable insights into the cognitive profiles associated with sports participation and family influences. Objective: This study aimed to identify the prevailing brain dominance patterns among young competitive swimmers and their parents and to examine the relationship between the brain dominance patterns of swimmers and those of their parents. Methods: A descriptive correlational design was employed. The study involved 50 young competitive swimmers registered with the Jordanian Swimming Federation at Al-Hassan City Club and one parent for each swimmer. Participants were selected using purposive sampling. Brain dominance was assessed using the Diane Brain Dominance Scale (2005), which was translated and culturally adapted into Arabic. The instrument demonstrated excellent internal consistency (Cronbach's $\alpha = 0.981$). Descriptive statistics and Pearson's correlation coefficient were used to analyze the data. Results: The integrated brain dominance pattern was the most prevalent among both young competitive swimmers and their parents. In addition, a strong positive correlation was found between the brain dominance patterns of swimmers and those of their parents ($r = 0.812$, $p < 0.001$). Conclusion: The findings indicate that both young competitive swimmers and their parents predominantly exhibit an integrated brain dominance pattern. The significant positive association between swimmers and their parents suggests that familial cognitive characteristics may be related to the development of similar brain dominance profiles. Future studies involving larger and more diverse samples are recommended to further investigate this relationship.

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Keywords: Brain dominance; Young competitive swimmers; Parents; Cognitive characteristics; Motor learning; Sports psychology.

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INTRODUCCIÓN

Brain dominance is a cognitive concept that describes the tendency of individuals to preferentially process information using specific hemispheric functions of the brain. Although both cerebral hemispheres interact continuously, each hemisphere has been associated with distinctive cognitive characteristics (Al-Ghanim & Hajjaj, 2021). The left hemisphere is generally linked to analytical reasoning, logical thinking, sequential information processing, and verbal communication, whereas the right hemisphere is commonly associated with creativity, intuition, spatial awareness, emotional processing, and holistic thinking (Diane, 2005). Contemporary neuroscience, however, emphasizes that effective cognitive functioning depends primarily on the integration of both hemispheres rather than the dominance of one hemisphere alone (Dhingar & Sharma, 2012). Consequently, the concept of integrated brain dominance has gained increasing attention in educational psychology and sport sciences because it reflects balanced cognitive processing that supports complex learning and performance (Al-Tarawneh, 2022).

In sport settings, cognitive abilities play an essential role in the acquisition and execution of motor skills (Ozden, 2008). Successful athletic performance depends not only on physical fitness but also on attention, perception, decision-making, anticipation, information processing speed, and motor planning (Badr, 2020). These cognitive processes are particularly important in swimming, where athletes are required to coordinate precise body movements while simultaneously responding to coaches' instructions, race strategies, and environmental conditions (Hadjisavvas et al., 2024). Individual differences in brain dominance may therefore influence how athletes learn technical skills, process feedback, solve performance-related problems (Pei et al., 2021), and adapt to changing competitive situations (Al-Rawashdeh, 2022).

Young athletes develop within family environments that substantially influence their cognitive, emotional, and behavioral characteristics (Al-Tarawneh, 2022). Parents contribute to children's development through communication styles, educational practices, emotional support, problem-solving approaches, and the learning opportunities they provide (Ozden, 2008). Previous research has consistently demonstrated that parental involvement is associated with children's motivation, confidence, self-regulation, and athletic development (Al-Rawashdeh, 2022). Since cognitive styles are shaped by both biological predispositions and environmental experiences, similarities in brain dominance patterns between parents and their children may reasonably be expected (Bandow & Mishra, 2016). Examining these similarities may provide valuable insights into the interaction between family influences and cognitive development in youth sport.

Previous studies have investigated brain dominance in educational contexts, cognitive learning styles, academic achievement, creativity, and decision-making (Al-Ghanim & Hajjaj, 2021; Al-Rawashdeh, 2022; Al-Tarawneh, 2022; Anaqrah, & Qaidoum, 2021; Refaat, 2016). Other studies have explored cognitive characteristics associated with athletic performance, including attention control, executive functioning, perceptual abilities, and motor learning (Azriel, 2012; Badr, 2020; Montgomery, 2024). Despite these contributions, relatively limited research has examined brain dominance patterns among young competitive swimmers. Furthermore, few studies have investigated whether similarities exist between the brain dominance profiles of young athletes and those of their parents. Consequently, empirical evidence explaining the relationship between familial cognitive characteristics and brain dominance in competitive sport remains limited.

Understanding brain dominance patterns among young swimmers and their parents has several practical implications. Knowledge of athletes' cognitive preferences may assist coaches in selecting instructional strategies that accommodate individual learning characteristics and facilitate skill acquisition. Likewise, understanding parental cognitive profiles may improve communication between coaches and parents and contribute to the design of educational and psychological support programs that enhance athlete development. Such information may also support multidisciplinary approaches integrating coaching, sport psychology, and family engagement in youth sport.

Accordingly, the present study sought to identify the prevailing brain dominance patterns among young competitive swimmers and their parents and to examine the relationship between their brain dominance profiles. By addressing this

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underexplored area, the study contributes to the growing body of literature examining cognitive characteristics in youth sport and provides evidence that may support more individualized coaching practices and greater parental involvement in athlete development.

Methodology

This study employed a descriptive correlational research design to identify the prevailing brain dominance patterns among young competitive swimmers and their parents and to examine the relationship between their brain dominance profiles. The design was considered appropriate because it enables the description of existing characteristics and the investigation of relationships among variables without manipulating the study conditions.

The study population consisted of young competitive swimmers registered with the Jordanian Swimming Federation and training at Al-Hassan City Club in Jordan.

A purposive sampling technique was adopted to recruit participants who met the study inclusion criteria. Initially, 70 swimmers were recruited. Twenty swimmers participated in a pilot study conducted to evaluate the clarity, validity, and reliability of the Arabic version of the instrument and were excluded from the primary analysis. Consequently, the final study sample comprised 50 young competitive swimmers and one parent for each swimmer, resulting in a total sample of 50 participants.

Participants were eligible if they were officially registered with the Jordanian Swimming Federation, actively participating in regular training programs during the study period, and had parental consent to participate. Parents voluntarily completed the same instrument independently.

Brain dominance was assessed using the Diane Brain Dominance Scale (Diane, 2005), which was originally developed to identify individuals' dominant cognitive processing patterns. The instrument classifies respondents into three primary brain dominance profiles: left-brain dominance, right-brain dominance, and integrated brain dominance.

The questionnaire consists of 21 paired statements (A/B format). Participants selected the statement within each pair that best described their preferred way of thinking or behaving. Responses were scored according to the instrument manual to determine the dominant brain profile for each participant.

Permission to use the Diane Brain Dominance Scale was obtained prior to conducting the study. The Diane (2005) Brain Dominance Scale was translated from English into Arabic using a forward–backward translation procedure. Two bilingual experts independently translated the original instrument into Arabic, and a third bilingual expert back-translated the Arabic version into English. The back-translated version was compared with the original instrument to ensure conceptual and linguistic equivalence.

Content validity was established through review by a panel of experts in sport psychology, educational psychology, and measurement and evaluation. The experts evaluated the clarity, relevance, and cultural appropriateness of each item, and their recommendations were incorporated into the final Arabic version.

The scale includes (21) questions, which are answered by choosing one of the two alternatives (A) or (B). Each question has one mark, and the maximum mark for the scale is (21) marks. Regarding the distribution of marks on the scale's questions, it is as follows: If the examinee answers alternative (A) for questions (1, 2, 3, 4, 7, 8, 9, 13, 14, 15, 19, 20, 21), he receives a mark, while for alternative (B) he receives zero. Responses were scored according to the original scoring key of the Diane Brain Dominance Scale. For Items 1, 2, 3, 4, 7, 8, 9, 13, 14, 15, 19, 20, and 21, selecting alternative A was assigned one point, whereas selecting alternative B received zero points. Conversely, for Items 5, 6, 10, 11, 12, 16, 17, and 18, selecting alternative B was assigned one point, whereas selecting alternative A received zero points. Total scores ranged from 0 to 21 and were classified as follows: 0–8 = Left Brain Dominance, 9–13 = Integrated Brain Dominance, and 14–21 = Right Brain Dominance.

To ensure the validity of the study instrument, it Content validity was established through expert evaluation. The panel confirmed that all questionnaire items were relevant, clear, and appropriate for measuring brain dominance among young swimmers and their parents.

Construct validity was examined through item-total correlation coefficients, all of which exceeded the minimum acceptable value.

Internal consistency reliability was evaluated using Cronbach's alpha coefficient. The Arabic version demonstrated excellent internal consistency

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(Cronbach's α = 0.981), indicating a high level of reliability for the study sample.

Table 1. *Correlation coefficients between the item and the total score*

Number Of Item	Correlation coefficients	Number Of Item	Correlation coefficients
1	.91**	12	.72**
2	.85**	13	.69**
3	.86**	14	.76**
4	.84**	15	.87**
5	.76**	16	.85**
6	.79**	**17**	.89**
7	.89**	**18**	.85**
8	.75**	**19**	.84**
9	.88**	**20**	.90**
10	.84**	**21**	.87**
11	.82**		

* Statistically significant at the 0.05 level. ** Statistically significant at the 0.01 level.

It should be noted that all correlation coefficients were statistically significant and acceptable; therefore, none of the items were removed.

Table 2. *Cronbach's alpha internal consistency coefficients for the study scale*

scale	Number of Item	consistency coefficients	Cronbach's alpha
Total	**21**	**0.874**	0.9**81**

Table (2) shows that Internal consistency was assessed using Cronbach's alpha coefficient, which yielded a value of 0.981, indicating excellent internal consistency. To evaluate the stability of the Arabic version over time, test–retest reliability was assessed using a pilot sample, resulting in a reliability coefficient of 0.874, which indicates satisfactory temporal stability. These findings demonstrate that the instrument possesses acceptable reliability for use in the present study**.**

Following ethical approval and permission from the Jordanian Swimming Federation and Al-Hassan City Club, participants and their parents were informed about the purpose of the study and the voluntary nature of participation. Written informed consent was obtained from parents prior to data collection.

Questionnaires were administered individually in a quiet environment before or after scheduled training sessions. Parents completed the questionnaire independently to minimize potential response bias. All completed questionnaires were checked for completeness before statistical analysis.

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Participation was entirely voluntary, and participants were informed of their right to withdraw from the study at any stage without any consequences.

Confidentiality and anonymity were maintained throughout all stages of the research process. Personal identifiers were removed before data analysis, and all collected information was used exclusively for scientific research purposes

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated to describe participants' characteristics and brain dominance patterns. Pearson's correlation coefficient was calculated using the continuous total scores obtained from the Diane Brain Dominance Scale rather than the categorical brain dominance classifications. Prior to the analysis, the assumptions of Pearson's correlation, including linearity, normality, and the absence of significant outliers, were examined and found to be satisfactory.

Result

Brain Dominance Patterns among Young Competitive Swimmers: The distribution of brain dominance patterns among young competitive swimmers is presented in Table 3. The findings indicate that the integrated brain dominance pattern was the most prevalent cognitive profile among the participating swimmers. In contrast, left-brain and right-brain dominance patterns were observed less frequently. These findings su ggest that most young competitive swimmers demonstrated balanced cognitive processing characteristics that integrate analytical and creative thinking abilities.

Table 3. *Mean and Standard Deviation of Responses from Sample Members on the Scale of Prevailing patterns of brain control (Right, Left, Integrated) among Swimmers*

Prevailing patterns of brain control	**n**	**%**	**Means**	**SD**
left	11	22.0	6.40	1.35
right	11	22.0	7.80	**2**.87
Integrated	28	56.0	12.26	4.861

Table (3) shows that the dominant brain control pattern (right, left, integrated) among swimmers is the (integrated) pattern, with mean (12.26) degrees**.**

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Brain Dominance Patterns among Parents: The distribution of brain dominance patterns among parents is presented in Table 4. Similar to the swimmers, the integrated brain dominance pattern represented the dominant cognitive profile among parents. Left-brain and right-brain dominance patterns occurred with considerably lower frequencies, indicating that integrated cognitive processing was the prevailing characteristic within the participating parents.

Table 4. *Mean and Standard Deviation of Responses from Sample Members on the Scale of Prevailing patterns of brain control (Right, Left, Integrated) among Parents of Swimmers*

Prevailing patterns of brain control	n	%	Means	SD
Left	15	30.0	5.92	1.28
Right	10	20.0	5.90	**1**.76
Integrated	25	50.0	10.20	3.839

Table (4) shows that the dominant brain dominance pattern (right, left, or integrated) among the players' parents is the integrated pattern, with a mean score of **.(10.20)**

Relationship between Brain Dominance Patterns of Swimmers and Their Parents: Pearson's correlation analysis was performed to examine the relationship between the brain dominance patterns of young competitive swimmers and those of their parents. As presented in Table 5, a strong positive correlation was identified between the two variables ($r = 0.812$, $p < 0.001$). This finding indicates that swimmers and their parents tended to exhibit similar brain dominance profiles. According to Cohen's interpretation of correlation coefficients, the observed relationship represents a strong association, suggesting that the brain dominance characteristics of young swimmers are positively related to those of their parents.

Table 5. *Pearson's Correlation Coefficient for Revealing the Correlation Between the Prevailing patterns of brain control (Right, Left, Integrated) in Swimmers and Their Parents*

Parents	Swimmers		
0.812	1	r	Swimmers
0.000	-	sig	
50	50	N	
1	0.812	r	Parents
-	0.000	sig	
50	50	N	

Table (5) shows that Pearson's correlation analysis revealed a statistically significant positive correlation between swimmers' and parents' brain dominance scores ($r = 0.812$, $p < .001$).

Discussion

The present study aimed to identify the prevailing brain dominance patterns among young competitive swimmers and their parents and to examine the relationship between their brain dominance profiles. Two principal findings emerged from the analysis. First, the integrated brain dominance pattern was the most prevalent among both young competitive swimmers and their parents. Second, a strong positive correlation was observed between the brain dominance profiles of swimmers and those of their parents. The predominance of the integrated brain dominance pattern among young competitive swimmers may reflect the cognitive demands associated with competitive swimming. Swimming requires athletes to simultaneously process technical instructions, regulate movement patterns, maintain concentration, monitor body position, and make rapid adjustments during training and competition. These requirements involve both analytical processes, typically associated with left-hemisphere functions, and spatial, perceptual, and creative processes, commonly attributed to right-hemisphere functions. Consequently, an integrated brain dominance profile may provide cognitive flexibility that supports efficient motor learning and performance.

This finding is consistent with contemporary perspectives in cognitive neuroscience, which argue that complex motor performance depends on the coordinated functioning of distributed neural networks rather than the dominance of a single cerebral hemisphere (Al-Rawashdeh, 2022). Modern theories increasingly emphasize functional integration between hemispheres as a prerequisite for efficient information processing, motor planning, and adaptive behavior. Therefore, the predominance of integrated brain dominance observed in the present study appears theoretically plausible within the context of youth sport development.

A similar pattern was identified among parents, with integrated brain dominance representing the dominant cognitive profile. This finding may reflect shared educational experiences, environmental influences, and cognitive interaction within family settings. Parents continuously influence children's

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cognitive development through communication, problem-solving strategies, behavioral modeling, and learning support. Although brain dominance cannot be considered exclusively environmentally determined, family environments may contribute to the development and reinforcement of preferred cognitive processing styles over time (Bandow & Mishra, 2016).

One of the most important findings of the present study was the strong positive correlation between swimmers' and parents' brain dominance profiles. This relationship suggests that young athletes and their parents tend to exhibit similar cognitive preferences. Several mechanisms may contribute to this association. First, children are exposed to parental communication styles and problem-solving approaches throughout development, which may shape cognitive preferences through observational learning and social interaction. Second, shared family environments may provide similar educational opportunities and experiences that influence cognitive development. Third, hereditary factors may also contribute to individual differences in cognitive characteristics, although the present study was not designed to distinguish between genetic and environmental influences.

The observed correlation should not be interpreted as evidence of a causal relationship. Rather, it indicates a statistically significant association between the brain dominance profiles of swimmers and their parents. Longitudinal and experimental studies are needed to determine the developmental mechanisms underlying this relationship and to clarify the relative contributions of biological and environmental factors.

From a practical perspective, the findings have important implications for coaching and athlete development. Recognizing athletes' cognitive preferences may assist coaches in selecting instructional methods that accommodate different learning styles, improve communication, and facilitate skill acquisition (Al-Tarawneh, 2022). In addition, involving parents in educational programs may strengthen cooperation between parents and coaches, thereby creating learning environments that better support young athletes' psychological and cognitive development.

Despite these contributions, several limitations should be acknowledged. The study employed a descriptive correlational design, which precludes causal inference. Participants were recruited from a single sports club using purposive sampling, limiting the generalizability of the findings. Furthermore, brain dominance was assessed using a self-report questionnaire rather than neurophysiological measurements. Future research should include larger and more diverse samples, multiple sports disciplines, longitudinal research designs, and objective neurocognitive assessment techniques to provide a more comprehensive understanding of brain dominance in youth athletes.

Conclusions

The present study provides evidence that the integrated brain dominance pattern represents the prevailing cognitive profile among young competitive swimmers and their parents. The findings also revealed a strong positive association between swimmers' and their parents' brain dominance profiles, suggesting that similarities in cognitive processing preferences may exist within family contexts. These results highlight the possible role of shared environmental experiences, family interactions, and developmental factors in shaping cognitive preferences among young athletes. From a practical perspective, understanding brain dominance patterns may assist coaches and parents in developing more effective communication strategies and individualized learning approaches that support athletes' cognitive and skill development. However, the findings should be interpreted within the limitations of the descriptive correlational design, as the study does not establish causal relationships between parental and athletes' brain dominance patterns. Future research using longitudinal approaches, diverse athletic populations, and objective neurocognitive assessments is recommended to further explore the mechanisms underlying the development of brain dominance patterns in young athletes.

Recommendations

The researcher recommends the following: Using training methods to develop the left hemisphere of the brain in order to stimulate motor learning skills, as well as some methods and feedback patterns to stimulate the right hemisphere for memory and recall skills. Conducting similar studies on different samples that include males and females. Holding training courses for swimming coaches that explain

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the importance of developing the mental skills associated with the right and left hemispheres.

Financing

The researchers declare that there is no Financing funded the research.

Conflict of Interest

The researchers declare that there is no conflict of interest.

Ethical Approval

The Ethics Committee of the Human Research Ethics Board (IRB), approved the ethical procedures of the research, taking into account the voluntariness, anonymity, and informed consent of the participants.

Data Availability Statement

The data used in this research is confidential and thus cannot be shared with third parties.

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Declarations

Author Contributions review of the literature, ideation, and creation of the original manuscript. review-editing and writing, Methodology, data analysis. All authors have read and approved the published on the final version of the article.

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