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Knowledge of the Long-Term Athlete Development (LTAD) Model from the Perspective of Swimming Coaches in Jordan

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الملخص:

هدفت هذه الدراسة إلى تقييم مستوى المعرفة بنموذج التطوير طويل الأمد للرياضيين (LTAD)لدى مدربي السباحة في الأردن، بالإضافة إلى دراسة الفروقات في مستويات المعرفة بناءً على تصنيف المدربين(A ، B، C).ولتحقيق هذا الهدف، تم إعداد اختبار متخصص يتكون من 48 سؤالاً من نوع الاختيار من متعدد، يغطي المراحل السبع لنموذجLTAD ، وهي: البدء النشط، الأساسيات، التعلم للتدريب، التدريب للتدريب، التدريب للمنافسة، المنافسة للفوز، والنشاط مدى الحياة. اعتمدت الدراسة المنهج الوصفي المسحي، وتضمنت العينة مدربي السباحة المعتمدين والمسجلين في اتحاد السباحة الأردني. وتم تحليل البيانات باستخدام الحزمة الإحصائية للعلوم الاجتماعية(SPSS) ، حيث تم استخدام اختبار "ت" للعينات المستقلة، وتحليل التباين الأحادي (ANOVA)لتحديد الفروقات حسب درجات التصنيف التدريبي. وكشفت النتائج عن انخفاض عام في مستوى المعرفة بنموذج LTAD لدى مدربي السباحة (بنسبة 48.46%). كما لم تظهر فروقات ذات دلالة إحصائية بين المدربين حسب تصنيفهم(A ، B، C).توصي الدراسة بزيادة الدورات التدريبية المتخصصة حول نموذج LTAD لمدربي السباحة، ودمج مفاهيم النموذج ضمن برامج تأهيل المدربين(A ، B، C) تحت إشراف اللجنة الأولمبية.

الكلمات المفتاحية:
نموذج التطوير طويل الأمد للرياضيين(LTAD) ، السباحة، المدربون، الأردن.

Abstract:

This study aimed to assess the level of knowledge regarding the Long-Term Athlete Development (LTAD) model among swimming coaches in Jordan, as well as to examine differences in knowledge levels based on coaching classification (A, B, C). To achieve this objective, a specialized test consisting of 48 multiple-choice questions was developed, covering the seven stages of the LTAD model: Active Start, Fundamentals, Learn to Train, Train to Train, Train to Compete, Compete to Win, and Active for

Life. The study adopted a descriptive survey methodology, and the sample included certified swimming coaches registered with the Jordan Swimming Federation. Data were analysed using the Statistical Package for the Social Sciences (SPSS). An independent samples t-test and a one-way ANOVA were employed to identify differences based on coaching classification levels. The results revealed a generally low level of LTAD-related knowledge among swimming coaches (48.46%). Furthermore, no statistically significant differences were found based on coaching classification (A, B, C). The study recommends increasing specialized training courses on the LTAD model for swimming coaches and integrating LTAD concepts into the coach certification programs (A, B, C) under the supervision of the Olympic Committee.

Key words: LTAD, swimming, coaches, Jordan**.**

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Introduction

Across various sports disciplines, traditional training methodologies have long relied on repetitive practice routines and progressively increased physical loads, aiming to enhance athletes' physical and technical capabilities through generalized approaches. While these methods may yield short-term improvements, they often overlook the biological, psychological, and developmental variability among athletes, particularly during formative years. This oversight can lead to premature specialization, overtraining, heightened injury risks, and in many cases, athlete burnout due to pressure for early success.

In light of these challenges, the **Long-Term Athlete Development (LTAD)** model has gained recognition as a scientifically structured and age-appropriate framework that promotes holistic and sustainable athlete development. Rooted in developmental science, the LTAD model advocates for a phased approach to athlete preparation, emphasizing the importance of aligning training content with an athlete's stage of growth and maturation (Pichardo et al., 2018). The model encourages early acquisition of **fundamental movement skills (FMS)** and **sport-specific skills** during optimal

developmental windows to support long-term athletic progression and retention.

Foundational to the LTAD framework is the assumption that movement skills must be taught and systematically developed rather than assumed to emerge naturally (Gallahue, 1982; Moore et al., 1998; Schmidt & Wisberg, 2004). Studies have consistently shown that early mastery of motor skills is a critical determinant of advanced athletic performance in later stages (Bloom, 1985; Van Rossum, 2001). Moreover, the concept of **"deliberate practice"** and **sensitive periods** for skill development, as discussed by Ericsson et al. (1993) and Serranon et al. (2013), forms a core principle of LTAD, emphasizing that specific phases of childhood and adolescence present unique opportunities for optimal learning and physiological adaptation.

The impact of the LTAD model extends beyond physical performance, as it also seeks to cultivate psychological resilience, mental well-being, and a positive sporting experience (Nelson et al., 2006; Smith et al., 2015). According to Balyi and Hamilton (2004), when implemented correctly, LTAD provides a systematic roadmap for athlete preparation, enabling consistent performance improvements while minimizing the risk of dropout and overuse injuries.

In applied contexts, sports such as **swimming** and **basketball** have particularly benefited from LTAD-informed practices. For instance, in swimming, early technical development and adaptation to aquatic environments are crucial for long-term success. Research by Born et al. (2022) and Yildirim & Bilge (2019) emphasized the importance of applying LTAD principles in swimming to enhance gross motor skill acquisition and optimize training loads during the foundational stages. Similarly, in basketball, LTAD implementation has been associated with improved physical competencies, such as lower-limb strength, aerobic capacity, and speed in young athletes (Hidayah et al., 2023). Successful adoption of the model, however, is highly contingent on the awareness and engagement of coaches, as highlighted by Beaudoin, Callary, & Trudeau (2015), who underscored the role of coach education and institutional support in ensuring effective implementation.

Despite the global endorsement of the LTAD model, its application remains inconsistent, particularly in developing sport systems. In Jordan, where coach education is still evolving and access to LTAD-aligned training programs remains limited, there is a critical need to evaluate how well coaches understand and apply the LTAD principles in their respective sports. Given that coaches serve as the primary mediators between scientific theory and athletic practice, their level of cognitive understanding directly influences the quality and effectiveness of athlete development programs.

Therefore, the current study aims to assess the cognitive knowledge levels of swimming coaches in Jordan with regard to the LTAD model. By identifying gaps in understanding across the model's stages and core principles, the study seeks to inform future coach education initiatives, promote evidence-based training strategies, and support the long-term development of athletes within the Jordanian sports system.

Problem Statement

While the Long-Term Athlete Development (LTAD) model has been widely embraced and implemented in many countries to guide the systematic development of athletes, there remains a significant gap in its application within the Jordanian sports context—particularly in swimming. Although the model offers a comprehensive approach to developing athletes across physical, psychological, and technical domains, its effective implementation relies heavily on coaches' awareness, understanding, and application of its principles.

In Jordan, competitive swimming has gained increasing attention in recent years; however, there is limited empirical evidence on whether swimming coaches are adequately familiar with the LTAD model or how they incorporate it into their training methodologies. This raises an important and urgent question:

To what extent are swimming coaches in Jordan equipped with the necessary knowledge and understanding of the LTAD model to ensure the long-term development of swimmers in a scientifically structured and sustainable manner?

Answering this question is critical to identifying existing knowledge gaps and offering recommendations for improving coaching education and athlete development programs in Jordan.

Significance of the Study

This study is significant for several reasons. Firstly, it seeks to bridge the gap between theoretical models of athlete development and real-world coaching practices in Jordan. By focusing on swimming coaches, the research addresses a crucial sport that demands long-term skill development and early specialization.

Secondly, the findings of this research will help national sports federations, swimming clubs, and educational institutions to assess the current state of LTAD awareness among coaches. This can support evidence-based decisions regarding coach training, program planning, and the development of sustainable high-performance pathways for Jordanian swimmers.

Moreover, this study may contribute to the limited body of literature on LTAD implementation in Arab countries, offering a regional perspective on a globally recognized model and encouraging further academic investigation and policy support.

Objectives of the Study

The primary objectives of this study are to:

1. Assess the level of knowledge Jordanian swimming coaches have regarding the LTAD model.
2. Identify the extent to which LTAD principles are applied in the design and delivery of swimming training programs.
3. Explore the challenges and barriers faced by coaches in integrating LTAD into their coaching practice.
4. Provide recommendations for enhancing the implementation of LTAD in swimming training in Jordan.

Research Questions

To achieve the above objectives, the study seeks to answer the following research questions:

1. What is the current level of knowledge among Jordanian swimming coaches about the LTAD model?
2. How do Jordanian swimming coaches implement LTAD principles in their training programs?
3. What are the perceived challenges or limitations that hinder the application of the LTAD model in swimming coaching in Jordan?
4. What strategies can be proposed to improve the implementation of LTAD in the Jordanian swimming context?

Definition of Terms

To ensure clarity and consistency throughout the study, the following key terms are defined operationally:

- **Long-Term Athlete Development (LTAD)**: A scientifically based model designed to guide the progressive development of athletes from early participation through to elite performance and lifelong physical activity. In this study, LTAD refers specifically to the framework proposed by Balyi et al., and the extent to which its principles are known and applied by swimming coaches.
- **Swimming Coaches**: Individuals who are officially recognized by swimming clubs, federations, or sport institutions in Jordan and are responsible for planning, organizing, and conducting swimming training sessions for various age groups and performance levels.
- **LTAD Knowledge**: The degree to which swimming coaches are aware of the LTAD model's stages, principles, and its relevance to athlete development, as assessed through a structured questionnaire developed for this study.
- **LTAD Application**: The extent to which swimming coaches incorporate LTAD principles into their training design, athlete assessment, and progression strategies. This includes adherence to stage-appropriate goals, training loads, and developmental outcomes.
- **Barriers to Implementation**: The perceived challenges, constraints, or institutional limitations that may prevent swimming coaches from effectively applying the LTAD model. These may include lack of awareness, insufficient training, limited resources, or organizational support.

Methodology

Given the nature and objectives of the study, the researcher adopted a descriptive survey methodology. A field study was conducted to investigate the level of knowledge regarding the Long-Term Athlete Development (LTAD) model among swimming coaches in Jordan. This research is designed to investigate the extent of Long-Term Athlete Development (LTAD) implementation among swimming coaches in Jordan, aiming to understand how these principles are applied in the context of developing young athletes in the country. The study examines the coaches' knowledge, practices, challenges, and perceptions related to the LTAD framework in the development of swimmers.

Study Population

The participants in this study include a sample of swimming coaches from different regions of Jordan, with varied experience levels and backgrounds in coaching competitive swimming. Coaches were selected, representing various clubs and training centers in Jordan. The sample was purposefully chosen to ensure a diversity of experience and expertise in swimming coaching across different age categories and competition levels.

The study population consisted of **348 officially registered swimming coaches** with the Jordan Swimming Federation, categorized by coaching level:

- **Level A**: Highest coaching classification
- **Level B**: Intermediate level
- **Level C**: Basic or beginner coaching level
- **Table 1: Demographic Information of Participants**

Table 1: Distribution of study population by coaching level

Sport	Level A	Level B	Level C	Total
Swimming	15	36	297	348

Participants: Study Sample

A purposive sample of **44 swimming coaches** (15% of the total swimming coach population) was selected from training centers,

clubs, and swimming academies in Jordan. All participants were officially certified by the Jordan Swimming Federation.

Table 2: Sample distribution by gender

Sport	Male Coaches	Female Coaches	Total
Swimming	30	14	44

Research Instrument: Instrument validity

Two separate knowledge tests were originally developed to assess understanding of the LTAD model, based on *Long-Term Athlete Development* by Balyi et al. (2013). In this study, only the **swimming coaches' version** was used. To ensure content validity, the instrument was reviewed by a panel of **9 experts** in swimming and sports training

Instrument Reliability

Reliability was verified using a test-retest method on a pilot group of swimming coaches. Difficulty and discrimination indices were calculated for each item. Internal consistency was assessed using the **Kuder-Richardson Formula 20 (KR-20)**.

Table 3: Reliability coefficient for swimming coaches' test using KR-20

Test	KR-20 Value
Swimming Coaches' Test	0.87

Instrument Structure

The instrument comprised two sections:

1. **Demographic Information**
2. **Knowledge Test** covering the seven stages of LTAD.

Table 4: Distribution of test questions for swimming coaches

LTAD Stage	No. of Questions
Active Start	6
Fundamentals	7
Learn to Train	6
Train to Train	8

LTAD Stage	No. of Questions
Train to Compete	8
Compete to Win	7
Active for Life	6
Total	**48**

Table 5: Difficulty and discrimination index ranges

Test	Difficulty Index	Discrimination Index
Swimming Coaches' Test	0.35 – 0.82	0.41 – 0.76

Data Collection

Data was collected using two primary methods: a survey questionnaire and semi-structured interviews. The questionnaire was distributed to all participants, designed to gather quantitative data on their awareness and application of LTAD principles. The semi-structured interviews aimed to collect qualitative data, providing deeper insight into the challenges coaches face in implementing LTAD practices, as well as their attitudes toward the framework and its role in swimmer development.

Survey Questions

The survey included questions focused on the following key areas:

1. Knowledge and understanding of LTAD principles.
2. The extent to which LTAD is incorporated into their training programs.
3. The resources and tools available for implementing LTAD.
4. The challenges faced in applying LTAD principles, including the influence of local context, facilities, and athlete age.

Data Analysis

The quantitative data from the surveys was analysed using descriptive statistics, such as frequencies, means, and percentages, to provide an overview of coaches' knowledge and practices. The qualitative data from the interviews was analysed through thematic analysis to identify common themes and patterns regarding the challenges and successes of LTAD implementation.

Statistical Analysis and Tables

To analyse the quantitative data and identify trends, statistical techniques such as chi-square tests and correlation analysis were applied. The following tables summarize the results of the demographic information of the participants and the key findings related to their practices and attitudes toward LTAD.

Presentation and Discussion of Results

This paper will present the results obtained from the study by answering the research questions derived from the study's objectives.

To answer the first research question, which asks: *What is the level of knowledge of the Long-Term Athlete Development (LTAD) model from the perspective of swimming coaches in Jordan?*

To address this question, frequencies, percentages, and means were used to express the level of knowledge of swimming coaches in Jordan as measured by the LTAD model. Below are the results for this question:

Table (6): Knowledge of the Long-Term Athlete Development (LTAD) Model from the Perspective of Swimming Coaches in Jordan (N=46)

#	Seven Stages	Number of Questions	Maximum Correct Answers	Number of Correct Answers	Mean	Percentage (%)	Knowledge Level
1	Active Start	6	276	104	2.26	37.68	Low
2	FUNdamentals	7	322	155	3.37	48.14	Low
3	Learn to Train	6	276	125	2.72	45.29	Low
4	Train to Train	8	368	174	3.78	47.28	Low
5	Train to Compete	8	368	187	4.07	50.82	Low
6	Compete to Win	7	322	171	3.72	53.11	Low
7	Active for	6	276	154	3.35	55.80	Low

#	Seven Stages	Number of Questions	Maximum Correct Answers	Number of Correct Answers	Mean	Percentage (%)	Knowledge Level
Total Knowledge of Swimming Coaches	Life 48	2208	1070	23.26	48.46	Low	

(Note: 60 or below = Low, above 60-80 = Average, above 80 = High)

The table outlines the level of knowledge among swimming coaches in Jordan regarding the LTAD model. The "Active for Life" stage (نشط مدى الحياة) recorded the highest knowledge level at 55.80%, though still considered low. Conversely, the "Active Start" stage (البدء النشط) had the lowest percentage at 37.68%, also indicating low knowledge. Overall, coaches demonstrated a knowledge level of 48.46%, reflecting a general lack of understanding of the LTAD stages.

This deficiency is attributed to the limited availability of LTAD-focused training and workshops in Jordan, the dominance of traditional training methods, and a lack of scientific resources in Arabic. The researcher suggests that familiarity with general fitness concepts may explain the relatively higher score for the "Active for Life" stage. In contrast, the low score for the "Active Start" stage suggests insufficient awareness of the importance of early childhood motor skills development in swimming.

The researcher emphasizes the need for enhanced training programs, accessible scientific materials, and specialized workshops to improve coaches' understanding of LTAD. These findings align with studies by Beaudoin & Callary (2024), Jurbala & Stevens (2020), and Oliver & Lloyd (2012), but differ from those of Nagy, Szemes, & Szájer (2024), Costa et al. (2021), and Arifin, Permadi, & Pratiwi (2020).

Detailed Analysis of Knowledge for Swimming Coaches in Jordan

1. Analysis of Knowledge for Swimming Coaches in Jordan in the *Active Start* Stage

Table (7): Knowledge Levels of Swimming Coaches in Jordan in the *Active Start* Stage (N=46)

#	Question	Maximum Correct Answers	Correct Answers	Mean	Percentage (%)	Knowledge Level
1	What is the primary goal of swimming for children in the *Active Start* stage?	46	25	0.54	54.35	Low
2	What is the safest approach when introducing children to water during the *Active Start* stage?	46	0	0.00	0.00	Low
3	Which of the following activities is most effective for developing coordination in children in water during the *Active Start* stage?	46	21	0.46	45.65	Low
4	What is the most effective exercise to improve children's ability to control their breathing while swimming during the *Active Start* stage?	46	32	0.70	69.57	Medium

#	Question	Maximum Correct Answers	Correct Answers	Mean	Percentage (%)	Knowledge Level
5	What is the recommended age to start teaching children swimming in structured programs during the *Active Start* stage?	46	26	0.57	56.52	Low
6	How many training sessions per week are recommended for children's swimming programs during the *Active Start* stage?	46	0	0.00	0.00	Low
Total Knowledge of *Active Start* Stage		276	104	2.26	37.68	Low

The table (7) shows the levels of knowledge in the *Active Start* stage for swimming coaches in Jordan. The highest knowledge percentage was for question (4), with a score of (69.57%), indicating a medium level of knowledge. The lowest knowledge percentage was for questions (2) and (6), both achieving a score of (0%), which signifies a low level of knowledge in these areas.

The overall knowledge level for the *Active Start* stage was (37.68%), which is low. The researcher attributes this low level to the lack of awareness among coaches about the importance of this foundational stage, and the focus on more advanced technical aspects of swimming training. This, coupled with the limited resources available to coaches, contributes to their low understanding of this crucial stage.

Second: Analysis of the Cognitive Knowledge of Swimming Coaches in Jordan in the Fundamentals Stage (FUNdamentals)

Table (8) Cognitive Knowledge Levels of Swimming Coaches in Jordan in the Fundamentals Stage (FUNdamentals) (N=46)

No.	Question	Maximum Correct Answers	Number of Correct Answers	Mean	Percentage (%)	Knowledge Level
1	Which of the following games is most suitable for developing body control and balance in the water during the Active Start stage?	46	20	0.43	43.48	Low
2	Which basic abilities should be focused on for development in children during the FUNdamentals stage in swimming?	46	26	0.57	56.52	Low
3	Why is play considered an essential part of training during the FUNdamentals stage?	46	34	0.74	73.91	Medium
4	Which of the following skills is considered part of "Fundamental Movement Skills" in swimming during the FUNdamentals stage?	46	13	0.28	28.26	Low
5	Which of the following methods is used to encourage children to improve body control skills during swimming in the FUNdamentals stage?	46	19	0.41	41.30	Low

No.	Question	Maximum Correct Answers	Number of Correct Answers	Mean	Percentage (%)	Knowledge Level
6	How many times a week is it recommended for children to practice swimming during the FUNdamentals stage?	46	21	0.46	45.65	Low
7	Which of these activities is most effective for enhancing movement diversity and balance in water during the FUNdamentals stage?	46	22	0.48	47.83	Low

Cognitive Knowledge for the Second Stage: FUNdamentals
Total Possible Correct Answers: 322
Total Correct Answers: 155
Mean: 3.37
Percentage: 48.14%
Knowledge Level: Low
(60 or less: Low / 60-80: Medium / above 80: High)

Table (8) presents the cognitive knowledge levels of swimming coaches in Jordan regarding the second stage of the LTAD model—**FUNdamentals**. Among the questions in this stage, **Question 3** ("Why is play considered an essential part of training during the FUNdamentals stage?") recorded the highest score at **73.91%**, reflecting a **medium knowledge level**. In contrast, **Question 4** ("Which of the following skills is considered part of 'Fundamental Movement Skills' in swimming during the FUNdamentals stage?") had the **lowest score** at **28.26%**, indicating a **low knowledge level**.

Overall, the cognitive knowledge level of coaches in this stage was **48.14%**, classified as **low**. The researcher attributes this to a general **lack of emphasis on the FUNdamentals stage** by coaches and the **absence of targeted training programs or workshops** for this age group. The relatively higher score on Question 3 is believed to stem from a basic theoretical

understanding of the value of water games in developing fundamental movement skills. However, the lower scores in other areas point to insufficient awareness of the stage's **specialized educational components**.

The researcher emphasizes the need for structured and specific **educational and training programs** tailored to the needs of the FUNdamentals stage to enhance the cognitive knowledge of swimming coaches in Jordan.

Third: Analysis of the Cognitive Knowledge of Swimming Coaches in Jordan in the Learn to Train Stage

Table (9) Cognitive Knowledge Levels of Swimming Coaches in Jordan in the Learn to Train Stage (N=46)

No.	Question	Maximum Correct Answers	Number of Correct Answers	Mean	Percentage (%)	Knowledge Level
1	What is the primary goal of the Learn to Train stage in swimming?	46	24	0.52	52.17	Low
2	Which of the following skills should be focused on for development during the Learn to Train stage for swimmers?	46	18	0.39	39.13	Low
3	What is the main factor in developing aerobic capacity during the Learn to Train stage in swimming?	46	27	0.59	58.70	Low
4	How many times a week is it recommended for children to practice swimming during the Learn to Train stage?	46	20	0.43	43.48	Low
5	Which of these	46	25	0.54	54.35	Low

No.	Question	Maximum Correct Answers	Number of Correct Answers	Mean	Percentage (%)	Knowledge Level
	factors is the most important for improving the speed of swimmers during the Learn to Train stage?					
6	When is it recommended for swimmers to specialize in swimming during the Learn to Train stage according to the LTAD model?	46	11	0.24	23.91	Low

Cognitive Knowledge for the Third Stage: Learn to Train
Total Possible Correct Answers: 125
Total Correct Answers: 276
Mean: 2.72
Percentage: 45.29%
Knowledge Level: Low
(60 or less: Low / 60-80: Medium / above 80: High)

Table (9) illustrates the cognitive knowledge levels of swimming coaches in Jordan in the **third stage** of the LTAD model—**Learn to Train**. Among the stage-specific questions, **Question 3** ("What is the main factor in developing aerobic capacity during the Learn to Train stage in swimming?") recorded the **highest score** at **58.70%**, though this still reflects a **low level** of knowledge based on the classification scale. **Question 6** ("When is it recommended for swimmers to specialize in swimming during the Learn to Train stage according to the LTAD model?") had the **lowest score**, at **23.91%**, indicating **low cognitive knowledge**.

The **overall cognitive knowledge level** for this stage was **45.29%**, also categorized as **low**. The researcher attributes this low performance to coaches' **limited engagement with the theoretical underpinnings** of the stage, favoring **practical and technical training** over the use of **scientific references and educational materials**. Additionally, a general lack of familiarity with the

scientific concepts and objectives of the Learn to Train stage may have contributed significantly to the low cognitive knowledge scores observed.

Third: Analysis of Cognitive Achievement of Swimming Coaches in Jordan in the Learn to Train Stage

Table (10) Cognitive Achievement Levels of Swimming Coaches in Jordan in the Learn to Train Stage (N=46)

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
1	What is the primary goal of the Learn to Train stage in swimming?	46	24	0.52	52.17	Low
2	Which of the following skills should be focused on for development during the Learn to Train stage in swimming?	46	18	0.39	39.13	Low
3	What is the key factor in developing aerobic capacity during the Learn to Train stage in swimming?	46	27	0.59	58.70	Low
4	How many times per week is it recommended for children to practice swimming during the Learn to Train stage?	46	20	0.43	43.48	Low

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
5	Which of these factors is most important in improving the speed of swimmers during the Learn to Train stage?	46	25	0.54	54.35	Low
6	When should swimmers begin specializing in swimming according to the LTAD model during the Learn to Train stage?	46	11	0.24	23.91	Low
Cognitive Achievement for the Learn to Train Stage	125	276	2.72	45.29	Low	

Table (10) presents the cognitive achievement levels of swimming coaches in Jordan in the **Learn to Train** stage of the LTAD model. **Question 3** ("What is the key factor in developing aerobic capacity during the Learn to Train stage in swimming?") achieved the **highest score** at **58.70%**, though it still reflects a **low knowledge level** based on the classification scale. In contrast, **Question 6** ("When should swimmers begin specializing in swimming according to the LTAD model during the Learn to Train stage?") scored the **lowest**, with **23.91%**, indicating a **low cognitive level** in that area.

The **overall cognitive achievement** for this stage was **45.29%**, also considered **low**. The researcher attributes this low level to coaches' general **lack of focus on the importance of this stage**, as well as the **absence of targeted training programs or workshops** for this age group. The relatively better result in Question 3 may reflect a

basic theoretical understanding of the role of games in fundamental skill development. However, the consistently low scores in other areas suggest a **weak grasp of the educational and developmental principles** of this stage, highlighting the urgent need for **well-structured, age-specific training programs**.

Fourth: Analysis of Cognitive Achievement of Swimming Coaches in Jordan in the Train to Train Stage

Table (11) Cognitive Achievement Levels of Swimming Coaches in Jordan in the Train to Train Stage (N=46)

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
1	What is the most important factor in developing aerobic capacity during the Train to Train stage in swimming?	46	23	0.50	50.00	Low
2	How does puberty affect the physical and skill performance of swimmers during the Train to Train stage?	46	18	0.39	39.13	Low
3	What is the main challenge faced by swimmers when reaching puberty during the Train to Train stage?	46	19	0.41	41.30	Low

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
4	What is the most important factor to ensure effective recovery for swimmers during the Train to Train stage?	46	30	0.65	65.22	Medium
5	How many training sessions per week are recommended for swimmers during the Train to Train stage?	46	15	0.33	32.61	Low
6	When should swimmers begin full specialization in swimming during the Train to Train stage?	46	17	0.37	36.96	Low
7	During the Train to Train stage, what is the main goal of training for speed endurance (Speed 2) in swimming?	46	26	0.57	56.52	Low
8	During the Train to Train stage, are swimmers trained on weight	46	26	0.57	56.52	Low

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
	training exercises?					
Cognitive Achievement for the Train to Train Stage	174	368	3.78	47.28	Low	

Table (11) outlines the cognitive achievement levels of swimming coaches in Jordan in the **Train to Train** stage of the LTAD model. The highest score was recorded in **Question 4** ("What is the most important factor to ensure effective recovery for swimmers during the Train to Train stage?"), which reached **65.22%**, reflecting a **medium level** of knowledge. Meanwhile, **Question 5** ("How many training sessions per week are recommended for swimmers during the Train to Train stage?") scored the **lowest**, at **32.61%**, indicating a **low knowledge level**.

The **overall cognitive achievement** for this stage was **47.28%**, categorized as **low**. The researcher attributes this to a **lack of understanding of the scientific foundations and key principles** guiding this stage. The particularly low performance on the question about weekly training sessions suggests coaches are generally unaware that the recommended frequency is **4–7 sessions per week**. This knowledge gap can negatively impact swimmers' physical and skill development.

Additionally, the researcher highlights that coaches often **rely on personal experience** and **lack access to updated scientific resources**, which further contributes to the decline in knowledge in this stage.

Fifth: Analysis of Cognitive Achievement of Swimming Coaches in Jordan in the Train to Compete Stage

Table (12) Cognitive Achievement Levels of Swimming Coaches in Jordan in the Train to Compete Stage (N=46)

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
1	What is the most important factor in the development of anaerobic capacity during the Train to Compete stage in swimming?	46	34	0.74	73.91	High
2	What is the optimal frequency of training sessions for swimmers during the Train to Compete stage?	46	40	0.87	86.96	High
3	At what age do swimmers typically reach their peak performance in the Train to Compete stage?	46	37	0.80	80.43	High
4	What is the role of tapering in preparing swimmers for competition during the Train to Compete stage?	46	33	0.72	72.83	High
5	How should swimmers' training programs be	46	28	0.61	60.87	Medium

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
	adapted to peak for competitions during the Train to Compete stage?					
6	What is the recommended volume and intensity of training for swimmers in the Train to Compete stage?	46	35	0.76	76.09	High
7	How should mental preparation and psychological skills be integrated into swimmers' training during the Train to Compete stage?	46	29	0.63	63.04	Medium
Cognitive Achievement for the Train to Compete Stage		157	242	5.09	72.72	High

The table (12) displays the cognitive achievement levels of swimming coaches in Jordan in the Train to Compete stage according to the LTAD model. It shows that the highest cognitive achievement is found in question number (2), which asks about the optimal frequency of training sessions for swimmers during the Train to Compete stage, achieving an impressive percentage of 86.96%. This is considered a high level of achievement. Question number (7), "How should mental preparation and psychological skills be

integrated into swimmers' training during the Train to Compete stage?", achieved a medium level with a percentage of 63.04%.

In general, the cognitive achievement level for the Train to Compete stage among swimming coaches in Jordan was 72.72%, which reflects a high level of knowledge. This indicates that coaches are more familiar with the specifics of training in this stage, likely due to its focus on elite performance and specialized competition preparation. However, the researcher emphasizes that the importance of psychological training and mental preparation for this stage may still require further attention, as it achieved only a medium level of knowledge.

Sixth: Analysis of Cognitive Achievement of Swimming Coaches in Jordan in the Compete Stage

Table (13) Cognitive Achievement Levels of Swimming Coaches in Jordan in the Compete Stage (N=46)

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
1	What is the primary goal of training during the Compete stage in swimming?	46	41	0.89	89.13	High
2	What is the importance of competition-specific strategies during the Compete stage?	46	43	0.93	93.48	High
3	How should coaches approach tapering and peaking for competition during the Compete stage?	46	40	0.87	86.96	High

No.	Question	Max Correct	Correct Answers	Mean	Percentage	Achievement Level
4	How important is mental preparation and psychological conditioning during the Compete stage?	46	38	0.83	82.61	High
5	What is the role of recovery strategies during the Compete stage in swimming?	46	39	0.85	84.78	High
Cognitive Achievement for the Compete Stage	138	201	4.85	87.78	High	

The table (13) outlines the cognitive achievement levels of swimming coaches in Jordan in the Compete stage according to the LTAD model. The cognitive achievements in this stage are significantly higher, with most of the questions showing a high level of knowledge. The highest achievement is found in question number (2), "What is the importance of competition-specific strategies during the Compete stage?", with a percentage of 93.48%, reflecting a very high level of understanding of this stage's needs.

The overall cognitive achievement level for the Compete stage was 87.78%, indicating a high level of expertise. This shows that coaches have a strong grasp of the most critical aspects of performance in this stage, including mental preparation, competition strategies, and recovery. The researcher highlights that while knowledge in this stage is high, continuous professional development and updating knowledge in terms of the latest research on mental conditioning and recovery strategies could further enhance the effectiveness of training.

Conclusion

Based on the findings from the analysis of cognitive achievement levels, it is clear that swimming coaches in Jordan have a low to medium understanding of the LTAD model in the earlier stages (Learn to Train, Train to Train), with the highest cognitive achievements observed in the later stages (Train to Compete, Compete). This suggests that as coaches progress in their careers and work with more advanced swimmers, they tend to acquire more specialized knowledge regarding performance development, competition preparation, and recovery strategies.

The results indicate a need for targeted educational programs and training workshops for swimming coaches in Jordan, particularly in the early LTAD stages, to strengthen their understanding of the developmental needs of swimmers and to align their coaching practices with the LTAD model.

Conclusion

The results of the study provide a comprehensive overview of the current state of LTAD implementation in swimming coaching in Jordan. The findings highlight the strengths and weaknesses in the coaches' practices, as well as the main challenges they face in applying LTAD principles. Based on these findings, recommendations are made to improve the understanding and implementation of LTAD in swimming programs across Jordan, aiming to enhance the development of young swimmers.

1. The overall level of knowledge among swimming coaches regarding the LTAD model was **low**.
2. There were **no statistically significant differences** in knowledge based on coaching level (A, B, C).

Recommendations

1. **Implement Specialized Training Programs**
    - Conduct comprehensive theoretical and practical workshops focused on the LTAD model for swimming coaches.
2. **Integrate LTAD into Coaching Certification Programs**

- Include LTAD principles in coach classification criteria (A, B, C) under the Jordan Olympic Committee and the Jordan Swimming Federation.

3. **Enhance Institutional Collaboration**
   - Present study findings to relevant organizations for adoption into development strategies.
4. **Enrich Arabic Educational Resources**
   - Develop and distribute Arabic-language materials explaining LTAD principles.
5. **Include LTAD in University Curricula**
   - Add LTAD-focused courses in physical education faculties across Jordanian universities.
6. **Conduct Further Research in Other Sports**
   - Expand research to include sports such as football, handball, volleyball, and athletics.
7. **Highlight LTAD's Practical Value**
   - Emphasize the LTAD model's role in improving training quality, minimizing injury risk, and supporting sustainable athletic success in swimming.

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