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Technology and its role in the process of standardizing and monitoring training loads from the coaches' perspective.

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Abstract

The study aimed to identify the use of technology in the process of rationing and monitoring training loads from the trainers' point of view For this purpose, the researcher used the descriptive method through an electronic questionnaire tool sent to a sample of 47 trainers across the national territory, After analyzing the findings, the researcher found that lack of knowledge and knowledge of the technological means available and the lack of clubs' access to them from the point of view of the coaches contributed to the reluctance to use them in training. Modern technology plays a role in the legalization and control of training loads.

Introduction:

There is no doubt that rapid technological advancement has greatly contributed to the massive increase in the volume of data and information collected about sports activities and related aspects(Decroos et al., 2018). This advancement in data collection, analysis, and comparison has been clearly reflected in the sports field, especially in football. As a result, those involved in sports coaching have come to rely on the latest methods, techniques, theories, and tools to monitor athletes and manage training(Vanrenterghem et al., 2017). All of this aims at achieving the best athletic results and breaking top performance records. In recent years, the process of monitoring training load in the world of sports has gained considerable momentum. This may be attributed to several factors, the most important of which are technological advancements and improved equipment for identifying and structuring training activities(Halson, 2014). The reason behind this growing interest lies in the need to improve the design of training programs and exercise routines, and to individualize them in order to enhance athletic performance, avoid overtraining, and prevent training overload that could lead to injuries and illnesses(Kyle, 1991). Monitoring training load and athletes' responses—such as fitness, fatigue, performance, and well-being—is critically important for making informed decisions regarding training prescriptions and recovery strategies(Bourdon et al., 2017). However, comprehensive and purposeful monitoring of the training process requires a precise distinction between different types of responses—such as stress, recovery, and adaptation—all of which may affect heart rate metrics(Thorpe et al., 2017). The primary goal of training is to enhance human capabilities in all their dimensions. These capabilities are characterized by physical, physiological, motor, and psychological attributes. Their optimal development involves structured and progressive training aimed at maximizing performance and overall athletic potential(Bourdon et al., 2017). For example, in fitness assessments, there are inherent limits to human performance. Therefore, training programs must be designed to push these functional boundaries in order to enhance adaptation, overall readiness, and ultimately improve competitive performance(Jagim et al., 2021). Most importantly, current technological advancements have enabled continuous improvement in the quantitative measurement of both internal and external load indicators during sports activity, as well as the expansion of a wide range of tools available for assessing training responses(Cardinale & Varley, 2017). Ideally, however, handling the collected data presents a major challenge for researchers and practitioners, and the available analytical

strategies are rarely investigated in a systematic manner(Thorpe et al., 2015). In this context, it is essential to clarify how individual longitudinal data should be analyzed on the one hand, and in what form various parameters should be interconnected on the other. The rapid technological advancements the world is witnessing have brought about fundamental changes in many aspects of life. The need to utilize technology has become a pressing necessity to facilitate individuals' daily lives(الشهومية & العبدلية, 2020). The qualitative and rapid development brought about by the technological revolution—especially since the twentieth century—in the field of information technologies has led to the emergence of new applications and software characterized by diversity and continuous innovation, which has intensified competition in the provision of services(Coutts & Cormack, 2014).

This cognitive and technological advancement witnessed globally in various fields of knowledge—particularly in sports sciences—and the current level of football in our country, especially in the broader context of sports, appears to have created a significant gap between us and the rest of the world. The latter has increasingly adopted the latest technological tools to facilitate coaches' work on the field. However, the complexity of these tools and the requirements for their effective use—such as specialized knowledge, familiarity with the technology, and hands-on training through workshops and instructional sessions—make their adoption challenging. Given that the coach has become the backbone of the training process, and based on our communication with some of them during various events, as well as through direct observation of coaches' practices in the field, and our review of several prior studies relevant to our topic, we cite the following as examples that informed and supported the foundation of our research The study by Baka Abdullah titled "The Integration of Modern Technological Tools in the Training Process of Team Sports" (Abdullah & Wissam, 2022), which aimed to identify the extent to which modern technological tools are used in team sports training by coaches. Another relevant study is that of Souidi Rabiha titled "The Use of Modern Technological Tools in the Formation and Training of Sports Clubs Between Reality and Aspiration" (Rabiha, 2021). Based on the above, the research problem emerged and was defined as follows: To what extent are technological tools used in the regulation and monitoring of training loads from the perspective of football coaches? Accordingly, this study seeks to answer the following general research question:

To what extent are technological tools employed in the process of regulating and monitoring training loads for football players, from the perspective of their coaches?

1. **Literature Review**

1.1 A study by Baka Abdullah titled "The Integration of Modern Technological Tools in the Training Process of Team Sports", published in Al-Manzuma Al-Riyadiya Journal, Volume 9, Issue 2, pages 51–63(& بافة عبدالرحمان, 2022). This study aimed to identify the extent to which modern technological tools are used in the sports training process for team sports by coaches. The researcher employed the descriptive method using a questionnaire tool applied to a sample of 20 coaches from the cities of Khemis Miliana and Miliana in the Wilaya of Aïn Defla. The researcher concluded that the coaches' lack of cognitive competencies contributes to their reluctance to use technological tools in training, and that the use of technological tools positively contributes to enhancing the training process.

1.2 A study by Souidi Rabiha titled "The Use of Modern Technological $Tools in the Formation and Training of Sports Clubs: Between Reality and Aspiration", published in Al-Manzuma Al-Riyadiya Journal(سويدي & شريط, 2021). This study aimed to investigate the current state of applying technological innovations in the field of sports training. The analytical descriptive method was used, and a questionnaire form was employed as the study tool, distributed to a sample of 50 coaches from the Wilaya of M'sila. The results revealed that the lack of attention to training in computer technologies is one of the main obstacles to the use and understanding of such technologies. Based on these findings, the research problem emerged, which focused on the extent to which technological tools are used in the regulation and monitoring of training loads from the perspective of football coaches.

2. **Method and Tools:**

This section includes the following elements:

2.1 Adopted Methodology:

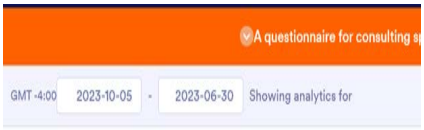
We employed the scientific descriptive method as a tool to obtain up-to-date knowledge, information, and facts relevant to this field, as it is considered one of the most important means used for data collection.

2.2 Sample and Sampling Method:

The research population in our study consists of football coaches distributed across the national territory. The sample was selected randomly and included 47 coaches who are active throughout the country.

3. Fields of the Study

3.1 Time Frame: This research was conducted during the period from June 30, 2023, to October 5, 2023.



3.2 Spatial Scope: The research was conducted across the national territory

3.3 Human Scope: It was represented by football coaches of senior categories and under 21 years.

4. Participants

The research population in our study consists of football coaches distributed across the national territory. The sample was selected randomly, and it included 47 coaches who are active across the national territory.

Academic Qualifications

Qualification	*Responses*	*Percentage (%)*
Baccalaureate	01	2.32%
Bachelor's (Licence)	11	25.58%
Master's	20	25.00%
Doctorate	02	4.65%
No Certificate	10	23.25%

Technical Certifications

Certification Level	*Responses*	*Percentage (%)*
First Level	14	30.23%
Second Level	18	41.18%
Third Level	07	17.50%
Other Certificates	05	11.62%

What position do you hold in training?

Position	***Responses***	***Percentage (%)***
Head Coach	28	63.60%
Assistant Coach	16	36.36%

How many years have you held this coaching position?

Duration	*Responses*	*Percentage (%)*
1–5 years	12	28.57%
6–10 years	14	33.33%
More than 10 years	*18*	*38.10%*

What is the age category of the team you currently coach?

Team Age Group	*Responses*	*Percentage (%)*
Seniors (Adults)	13	54.29%
Under 21	28	63.63%
Other Team	03	81.60% *(Likely a data entry error)*

5. Materials

5.1 Tool:

In this study, we, as a research group, relied on a questionnaire in the form of an electronic form designed via the **JOTFORM** platform, with the aim of collecting as many ideas, opinions, and pieces of information as possible on the topic of the study. This was achieved by responding to a number of proposed questions and verifying the suggested hypotheses as temporary solutions.

Source: The platform (Jotform, Tank, 2006)

The questionnaire consists of 12 questions, distributed as follows:

1. First Section: 4 questions, which are closed-ended questions.
2. Second Section: 5 questions, which are closed-ended questions.
3. Third Section: 4 questions, which are closed-ended questions

5.2 Statistical Tools:

The statistical analysis was conducted using the following tools:

- Percentage (%) = (Part / Total Value) × 100
- Cronbach's Alpha Coefficient

Chi-Square Test (χ^2 Test)

- O: Observed frequency
- E: Expected frequency
- Degrees of Freedom (df):
  The formula is:
  df = (number of categories – 1)

6. Design and Procedure

This study aims to explore the opinions and perspectives of those involved in the training process, based on their viewpoints, and to identify some of the reasons why the majority of coaches do not rely on technological tools in the regulation and monitoring of training loads**.** The scientific significance of the study lies in shedding light on and uncovering the extent to which technological tools are being utilized, as well as identifying the reasons that have hindered their use—from the coaches' perspectives. These tools have become an integral part of the training process, as they contribute to the development and enhancement of athletes' physical abilities through the regulation and monitoring of training loads. As for the practical significance of the study**,** it lies in changing the perspective of coaches and those responsible for training sectors, and in highlighting the scientific importance of technological tools and their major role in monitoring and regulating training loads—an issue that has become a primary concern for everyone involved in the field of training.

7. Statistical Analysis

7.1 Hypotheses Analysis and Discussion

- First Hypothesis:

Question No. 01: Do you use modern technological tools in the regulation and monitoring of training loads?

Table 4: Responses to Question 01

Data	*Yes*	*No*	*No Answer*
Frequency	12	27	05
Percentage	27.27%	61.36%	11.36%

Data	*Observed (O)*	*Expected (E)*	*(O−E)²*	*(O−E)² / E (χ^2 component)*	*Critical Value (χ^2_t)*	*Significance*
Yes	12	19.5	56.25	2.88		
No	27	19.5	30.25	2.88	3.84	Significant
Total				5.76		

Through our analysis of Table No. "4", it became clear that the percentage of respondents who answered "No" exceeds that of those who answered "Yes", while those who did not respond were estimated at 11.36%. As for the statistical significance, the difference between the two responses is statistically significant.

Question 02: Do you have technological tools to compare data obtained through testing?

Table 5: Response to Question No. 02

Response Category	*Yes*	*No*	*No Response*
Frequency	08	33	03
Percentage (%)	18.18	75.00	6.81

Data	***Observed (O)***	***Expected (E)***	***(O−E)²***	***(O−E)² / E (χ² component)***	***Critical Value (χ²ₜ)***	***Significance***
Yes	08	20.5	156.25	7.62		
No	33	20.5	156.25	7.62	3.84	**Significant**
Total				**15.24**		

Through our analysis of Table No. "5", it was found that the percentage of those who answered "No" exceeds the percentage of trainers who answered "Yes". Additionally, the percentage of those who did not respond was estimated at 6.81%. In terms of statistical significance, the difference is statistically significant.

Question 03: Are you aware of the most important applications, platforms, and electronic programs available in the field of training?

Table 6: Response to Question No. 03-

Response	*Yes*	*No*	*No Answer*
Frequency	13	28	3
Percentage (%)	29.54%	63.63%	6.81%

Response	*Observed (O)*	*Expected (E)*	*(O - E)²*	*χ² (per item)*
Yes	13	20.5	56.25	2.74
No	28	20.5	56.25	2.74
Total χ^2				5.48

Through our analysis of Table No. "6", it is evident that the percentage of those who answered "No" exceeds the percentage of trainers who answered "Yes". Additionally, the percentage of those who did not respond was estimated at 6.81%. In terms of statistical significance, the difference between the "Yes" and "No" responses is statistically significant.

Question No. 04: Do you use electronic software to organize data and the results of tests administered to the players?

Table 7: Response to Question No. 04

Response	*Yes*	*No*	*No Response*
Frequency	14	30	0
Percentage (%)	31.81%	68.18%	0.00%

Response	*Observed (O)*	*Expected (E)*	*(O − E)²*	*χ² (per item)*
Yes	14	22	64	2.90
No	30	22	64	2.90
Total χ^2				5.80

Through our analysis of Table No. 7, it is evident that the percentage of respondents who answered "No" exceeds that of the trainers who answered "Yes". Additionally, the percentage of those who did not respond was 0%.

In terms of statistical significance, the difference between the two responses is statistically significant.

- Second Opportunity

Question No. 01: Do you believe that technological tools play a role in improving the players' training process?

Table 8: Response to Question No. 01

Response	*Frequency*	*Percentage (%)*
Yes (نعم)	29	65.90%
No (لا)	11	25.00%
No Response	4	9.09%

Response	*Observed (O)*	*Expected (E)*	*$(O-E)^2$*	*χ^2 (per item)*
Yes	29	20	81.00	4.05
No	11	20	81.00	4.05
Total χ^2				8.10

Through our analysis of Table No. 8, it is clear that the percentage of respondents who answered "Yes" exceeds that of the trainers who answered "No"**.** Additionally, the percentage of those who did not respond was estimated at 9.09%**.** From a statistical standpoint, the difference between the responses is statistically significant.

Question No. 02: Can the process of data analysis using technological tools help in standardizing and monitoring training loads?

Table 9: Response to Question No. 02

Response	*Frequency*	*Percentage (%)*
Yes (نعم)	28	63.63%
No (لا)	13	29.54%
No Response	3	6.81%

Response	*Observed (O)*	*Expected (E)*	*$(O-E)^2$*	*χ^2 (per item)*
Yes	28	20.5	56.25	2.74
No	13	20.5	56.25	2.74
Total χ^2				5.48

Through our analysis of Table No. 9, it is clear that the percentage of respondents who answered "Yes" exceeds that of the trainers who answered "No". Additionally, the percentage of those who did not respond was estimated at 6.81%. From a statistical perspective, the difference between the two responses is statistically significant.

Question No. 03: Can technology detect cases of overtraining before they occur?

Table 10: Response to Question No. 03

Response	*Frequency*	*Percentage (%)*
Yes (نعم)	32	72.72%
No (لا)	5	11.36%
No Response	7	15.90%

Response	*Observed (O)*	*Expected (E)*	*(O − E)²*	*χ^2 (per item)*
Yes	32	18.5	182.25	9.85
No	5	18.5	182.25	9.85
Total χ^2				19.70

Through our analysis of Table No. 10, it is evident that the percentage of respondents who answered "Yes" exceeds that of the trainers who answered "No". Additionally, the percentage of those who did not respond was estimated at 6.81%. From a statistical perspective, the difference between the two responses is statistically significant.

Question 04: Can technological means predict injuries and pathological conditions before they occur?

Table 11: Response to Question No. 04

Response	*Yes*	*No*	*No Answer*
Frequency	27	12	05
Percentage (%)	61.36	27.27	11.36

Response	*Observed (O)*	*Expected (E)*	*(O−E)²*	*(O−E)² / E*	*Tabulated χ^2*	*Significance*
Yes	27	19.5	56.25	2.88		
No	12	19.5	56.25	2.88	3.84	Significant
Total				5.76		

Based on our analysis of Table No. 11, it is evident that the percentage of respondents who answered "Yes" exceeds that of the trainers who answered "No". Additionally, the percentage of those who did not respond was estimated at 11.36%. From a statistical significance standpoint, the difference is statistically significant.

Question No. 05: Can technological tools help in controlling training loads?

Table 12: Response to Question No. 05

Response	*Yes*	*No*	*No Answer*
Frequency	34	06	04
Percentage (%)	77.27	13.63	9.09

Response	*Observed (O)*	*Expected (E)*	*(O−E)²*	*(O−E)² / E*	*Tabulated χ^2*	*Significance*
Yes	34	20	196	9.8		
No	06	20	196	9.8	3.84	Significant
Total				17.6		

Based on our analysis of Table No. 12, it is evident that the percentage of respondents who answered "Yes" exceeds that of the trainers who answered

"No". Additionally, the percentage of those who did not respond was estimated at 9.09%. From the perspective of statistical significance, the difference is statistically significant.

- Hypothesis No. 03

Question No. 01: Does your club have technological tools for regulating and monitoring training loads?

Table 13: Response to Question No. 01

Response	*Yes*	*No*	*No Answer*
Frequency	10	31	03
Percentage (%)	22.72	70.45	6.81

Response	*Observed (O)*	*Expected (E)*	*(O−E)²*	*(O−E)² / E*	*Tabulated χ²*	*Significance*
Yes	10	20.5	110.25	5.37		
No	31	20.5	110.25	5.37	3.84	Significant
Total				10.74		

Based on our analysis of Table No. 13, it is evident that the percentage of respondents who answered "No" exceeds that of the trainers who answered "Yes". Additionally, the percentage of those who did not respond was estimated at 6.81%. From a statistical significance standpoint, the difference is statistically significant.

Question No. 02: Does your club provide technological programs and applications for organizing players' data during assessment and test administration?

Table 14: Response to Question No. 02

Response	*Yes*	*No*	*No Answer*
Frequency	11	33	00
Percentage (%)	25.00	75.00	00.00

Response	*Observed (O)*	*Expected (E)*	*(O−E)²*	*(O−E)² / E*	*Tabulated χ²*	*Significance*
Yes	11	22	121	5.5		
No	33	22	121	5.5	3.84	Significant
Total				11.0		

Based on our analysis of Table No. 14, it is evident that the percentage of respondents who answered "No" exceeds that of the trainers who answered "Yes". No cases of non-response were recorded. From the perspective of statistical significance, the difference between the responses "Yes" and "No" is statistically significant.

Question No. 03: Does your club provide training in software and the use of technology in the field of coaching?

Table 15: Response to Question No. 03

Response	*Yes*	*No*	*No Answer*
Frequency	02	39	03
Percentage (%)	4.54	88.63	6.81

Response	*Observed (O)*	*Expected (E)*	*(O−E)²*	*(O−E)² / E*	*Tabulated χ²*	*Significance*
Yes	02	20.5	342.25	16.69		
No	39	20.5	342.25	16.69	3.84	Significant
Total				**33.38**		

Based on our analysis of Table No. 15, it is evident that the percentage of respondents who answered "No" exceeds that of the trainers who answered "Yes". Additionally, the percentage of those who did not respond was estimated at 6.81%. From a statistical significance perspective, the difference between the responses "Yes" and "No" is statistically significant.
Question No. 04: Have you received specialized training in data analysis and data organization (tabulation) related to your coaching field, funded by your club?

Table 16: Response to Question No. 04

Response	*Yes*	*No*	*No Answer*
Frequency	02	39	03
Percentage (%)	4.54	88.63	6.81

Response	*Observed (O)*	*Expected (E)*	*(O − E)²*	*(O − E)² / E*	*Tabulated χ²*	*Significance*
Yes	02	20.5	342.5	16.9		
No	39	20.5	342.5	16.9	3.84	Significant
Total				**33.8**		

Based on our analysis of Table No. 16, it is evident that the percentage of respondents who answered "No" exceeds that of the trainers who answered "Yes". Additionally, the percentage o those who did not respond was estimated at 6.81%. From a statistical significance perspective, the difference is statistically significant.

8. **Discussion and Interpretation of the Results**

- It is evident from Tables No. (4, 5, 6, and 7), and based on the analysis and interpretation of these tables, that the majority of coaches lack knowledge and awareness of the latest technological tools currently used and available in the field of training. This conclusion is supported by the responses to the sub-questions of this hypothesis, as the answers to the following questions leaned significantly toward the coaches who answered "No": Question 1: Do you use modern technological tools to regulate and monitor training loads? Question 2: Do you have technological tools to compare data obtained from tests? Question 3: Are you aware of the most

important applications, platforms, and digital programs available in the field of training? Question 4: Do you use digital software to organize data and test results applied to players? In all cases, the difference in responses was statistically significant, as shown in Tables (4, 5, 6, and 7). Therefore, we reject the original hypothesis, which assumed that coaches are knowledgeable and aware of the technological tools available in the field of training. Instead, we accept the alternative hypothesis, which denies the validity of the original one. This conclusion is supported by the study conducted by Khawla Miliani (2021), titled "The Role of Information Technology and Technological Tools in Modernizing Sports Training in Karate-do in the Clubs of Ouargla Province". The findings of this article showed a lack of exploitation and use of technological tools employed in competitions and sporting events. Furthermore, it is supported by the study of Bafa Abdallah (2022), titled "Integrating Modern Technological Tools into the Training Process in Team Sports", in which the author confirmed that the majority of coaches did not use information technology during the sports training process, with a reported rate of 80%. Accordingly, these results confirm the validity of our hypothesis stating that $coaches do not have awareness or knowledge of the technological tools available in the field of training.

- Lack of Technological Resources in Sports Clubs It is evident from
- Tables No. (13, 14, 15, and 16), and from the analysis and interpretation

of these tables, that most coaches believe there is a lack of technological tools provided by clubs to support the training process. This conclusion is based on responses to the sub-questions of this hypothesis, which were predominantly in favor of those who answered "No", specifically: Question 1: Does your club have technological tools for regulating and monitoring training loads? Question 2: Does your club provide technological programs and applications for organizing players' data during evaluation and testing? Question 3: Does your club offer training in software and the use of technology in coaching? Question 4: Have you received specialized training in data analysis and tabulation related to your coaching field, funded by your club? In all cases, the difference in responses was statistically significant, as shown in Tables (13 to 16). Therefore, we accept the hypothesis which states that most coaches believe there is a shortage in the availability of technological tools provided by clubs for use in the training process. This hypothesis is further supported by the study conducted by Bafa Abdallah (2022), which confirmed that sports clubs lacked

technological tools, with the reported shortage rate reaching 100%. Accordingly, these results further confirm the validity of our hypothesis that most coaches perceive a lack of technological tools provided by their clubs for use in the training process.

9. Conclusions

- Most coaches believe that there is a lack of technological tools provided by clubs for use in the training process, from their point of view.
- Modern technology plays a role in regulating and monitoring training loads, according to the coaches' opinions.
- Coaches do not possess sufficient awareness or knowledge of the technological tools currently available in the field of training.
- Coaches and trainees are able to acquire new skills and experiences in various fields easily and without the need to move between different locations.
- The use of technology facilitates teamwork through modern applications that reduce distances between trainees and coaches.
- Technological tools serve as valuable sources of information for both coaches and trainees to create new and effective training methods.
- Using technology in training programs can assist many coaches in efficiently collecting, rapidly reading, and interpreting large volumes of data and results—tasks that are difficult to accomplish using traditional/manual methods.

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