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Effect of tapering peak on physiological variables and Digital level of female cross-country runners

Prof. Dr/ Mustafa Mohammed Ahmed Nasr [(1)], Assist. Prof. Dr/ Ayman Mohammed Shehata [(2)]

(1) Professor of Sports Training, Department of Education and Movement Sciences - College of Education - Qassim University.

(2) Assistant Professor in the Department of Education and Movement Sciences - College of Education - Qassim University.

Abstract:

The Study Aimed to Identify the Impact of Tapering Peak Using The Linear Method On Some Physiological Variables And The Digital Level Of Female Cross-Country Race Athletes. The Experimental Method Was Used on A Deliberate Sample of Under-18Y Female Egyptian National Athletics Team Players. The Basic Research Sample Was (6), Whereby Tapering Peak Was Used During the Pre-Competition Period Within Their Training Program for Two Weeks. After Completing the Application, Post-Measurements Were Taken. Dimensioning The Study Sample, Processing the Data Statistically, Then Presenting and Discussing the Results. The Most Important Conclusions Were That Tapering Peak Had a Positive Effect on The Physiological Variables: Red Blood Cells (9.88%), Ferritin (28.22%), Erythropoietin (34.75%), And Finally Hemoglobin (2.32%), And Improving The Digital Level Of Young Female Cross-Country Athletes By (2.16). %) The Most Important Recommendation Was to Use The Tapering Peak Using A Linear Method In The Taper Phase Before Competitions Because Of Its Importance In Improving The Digital Level Of Young Female Cross-Country Athletes..

Keywords: *(tapering peak - physiological variables- Digital level)*

Introduction and research problem:

It is for sure that the field of sports training is one of the fields in which many scientists and researchers have conducted research and studies to find many solutions to the problems facing athletes to develop their levels to win championships.

athletics races and competitions, especially various distance-running events, including middle-distance races, are part of the training process during the general preparation phase of most, if not all sports activities, for their important role in developing the physical and functional efficiency of athletes. (1)

The researchers believe that one of the most important duties and goals of sports training in general, and training for athletics races and competitions in particular, is to bring the athlete to the highest possible athletic level. Therefore, the training process needed to be directed at preparing the competitor in a manner characterized by balance, comprehensiveness, and integration between all components of the sports training process. They are considering good regulation of training loads for variables of intensity, volume, and rest periods. Essam Abdel Khaleq (2003) emphasizes that training should be sequential between periods of pregnancy and rest. as the inter-rest period depends mainly on the intensity and volume of the load. Hence, the rest period is longer if the intensity of the load increases, and shorter if the intensity of the load decreases. (10)

Raysan Khuraibit and Abu Al-Ala Abdel-Fattah (2016) point out that an athlete suffers from overtraining when a balance is not achieved for a long period between the training load and recovery processes, which leads to a decrease in the level of performance. (24)

Both Muhammad Al-Qat (2013) and Ahmed Qutb (2005) agree that the goal of the taper phase is to reduce training loads, which must be planned by controlling the training components in terms of the type and number of training times per week, the duration of the daily training workout, and the intensity of the training, which leads to restoring recovery, preparing the athlete and enhance his abilities to participate in competition in the best sports performance to reach the peak of sporting achievement. (18) (3)

Musaad Mahmoud, 2017, and Zhiqiang Wang et al. (2023) point out that gradual tapering is a strategy to reduce pressure on the athlete immediately before the competition, to give the body and mind some time to get rid of the violence of pressure training to stimulate athletic performance at the right moment in the season. (19) (26)

As a result, Mojica et al. (2004) have highlighted since then that pre-competition training has declined, and research and study in this field began in 1980 to reach the physiological responses that characterize the body's systems, hormonal, nervous, muscular, and immune, in addition to metabolic processes for myocardium with functional metabolic of heart before competitions. (21)

Many studies recommend that the period of decreasing the training load before competition is between (7-20) days. Also, long-distance races require a longer period of reduced training load before the competition, and in general, this period shouldn't be shorter than (10). days.

This is what was highlighted by the results of the study of Gihad Abdel Mohsen (2014), citing Hawley. (2002), Bannister et al. (1999) that there are four types of reduction in training load before the competition, the linear decrease of training load (regular), the non-linear decrease (slow and rapid decrease), and finally the non-gradual decrease of

training load (the suddenly Reducing in mileage covered then maintaining them. (11)(5)

According to the findings of Zhiqiang Wang et al (2023), gradual reduction applied in conjunction with prior overtraining is more appropriate for achieving maximum performance gains. Current evidence suggests that 21-day tapering, where training volume is gradually reduced by (41-60%) without change in training intensity or frequency, is an effective tapering strategy. (26)

Ferritin is one of the types of proteins found in blood serum that generally reflects the total iron stored in the body. Whereas the results of the studies of Harper, J, Conrad, M. (2015)(13), DellaValle, DM (2013)(8), Yoshida, T, et al (1990)(25) indicate that generally the monitoring of Ferritin blood serum concentration, is one of the most important measurements for endurance athletes, and it also indicates that its decrease is one of the most important causes responsible for fatigue and decreased performance, even in the presence of normal levels of hemoglobin.

The hormone erythropoietin, as defined by Anaheim S, et al (2016), is a hormone produced primarily by the kidneys, and plays a major role in the production of red blood cells (RBCs), which transport oxygen from the lungs to the other parts of the body, and this is consistent with what was indicated. To Ji, P (2016) Jekmann, W (2011) The amount of erythropoietin released depends on the low level of oxygen. The process of producing red blood cells is controlled by the hormone erythropoietin and iron. (4) (16)(15).

From the above, and through the theoretical readings and field experiences of the researchers in the field of training and physiological measurements, and their follow-up of many local and international championships, it was noted that coaches lack interest in planning the load before the competition, especially for cross-country players. In addition to observing the digital numbers and results of local championships, the difference between global and local numerical levels becomes clear, and this is due to The researchers pointing this out to the random method of using training loads during the tapering phase among most athletics coaches and the failure to follow the scientific method, which is inconsistent with their importance, in addition to the rapid decline in the use of training volumes without care of the principle of balance between decreasing volumes and maintaining the training gains that the female athletes have achieved throughout the season. the decrease in training load shortly before competitions is of great importance from a physiological standpoint, and given that improving the functional efficiency of the players' vital organs positively affects their physical abilities and is reflected in their digital level, hence the importance of the study appears in trying to codify the use of training loads to determine the best suitable method for cross-country athletes so that it can be used in the tapering phase, especially for young women.

Research goal:

This research aims to identify the effect of the tapering peak using the linear method on some physiological variables and the digital level of female cross-country race athletes through:

1. Identify the effect of tapering peak using the linear method on the hormone erythropoietin (EPO) levels, red blood cells, hemoglobin, and ferritin for female cross-country race athletes.
2. Identify the effect of tapering peak using the linear method on the digital level for female cross-country race athletes.

Research hypotheses:

1. Tapering peak affects the hormone erythropoietin (EPO) levels, red blood cells, hemoglobin, and ferritin for female cross-country racers.
2. The tapering peak by the linear method affects the digital level of female cross-country athletes.

Scientific Importance of the research:

1. This study aims to systematically investigate the effects of tapering on key physiological variables, including maximal oxygen uptake (VO2 max), lactate threshold, muscle glycogen levels, and hormonal responses. By employing a controlled experimental design, the research will provide empirical data on how tapering influences these variables, thereby contributing to a deeper understanding of the physiological adaptations induced by tapering in female athletes.
2. In addition to physiological assessments, the study will incorporate digital performance metrics such as race times, pacing strategies, and heart rate variability. This comprehensive approach will enable a holistic evaluation of tapering's impact on competitive performance, integrating both physiological and digital data to inform evidence-based tapering protocols.
3. The findings from this research have the potential to significantly enhance training methodologies for female cross-country runners, leading to improved performance outcomes and reduced risk of overtraining. Furthermore, the study will contribute to the broader field of sports science by providing insights into gender-specific training adaptations and informing best practices for tapering across various endurance sports disciplines.

Previous research:

1. **The Training Characteristics of World-Class Distance Runners: An Integration of Scientific Literature and Results-Proven Practice (2022)**: This review integrates scientific literature and practical results to outline a framework for understanding the training and development of elite long-distance runners. It discusses tapering strategies and their impact on performance.
2. **Crossing the Golden Training Divide: The Science and Practice of Training World-Class 800- and 1500-m Runners (2021):** This article reviews the training methodologies of elite middle-distance runners, including tapering practices. It provides

insights into how tapering affects physiological and performance variables.

3. **Total Energy Expenditure, Energy Intake, and Body Composition in Highly Trained Athletes (2017)**: This study systematically analyzes energy expenditure, intake, and body composition in endurance athletes, providing valuable data that could be relevant to understanding the physiological impacts of tapering.
4. **Effects of Tapering on Performance in Endurance Athletes: A Systematic Review and Meta-Analysis (2023):** This paper provides a comprehensive review and meta-analysis of the effects of tapering on performance in endurance athletes. It discusses various tapering strategies and their impact on physiological and performance outcomes.
5. **Crossing the Golden Training Divide: The Science and Practice of Training World-Class 800- and 1500-m Runners (2021):** This review article integrates scientific literature and best practices to outline training methodologies for elite middle-distance runners, including tapering practices.
6. **The Training Characteristics of World-Class Distance Runners: An Integration of Scientific Literature and Results-Proven Practice (2022):** This review bridges the gap between scientific research and practical training methods for long-distance runners, highlighting the importance of tapering in training regimens

Research procedures:

The method used: the experimental method using one experimental group and applying pre-post measurement.

Spatial field: Athletics track at the Olympic Center

Time field:

The exploratory study, pre-test measurements, and the workouts of the tapering peak training program were implemented during the pre-competition period, and then post-competition measurements were applied in the period from 1/7/2023 till 31/7/2023.

Research sample:

The research sample was chosen intentionally from among the young female athletes for the under-18 cross-country race for (6) kilometers distance in the Egyptian athletics national team. It consisted of (6) female athletes, after excluding several (2) female athletes to conduct the exploratory study on them (4) young women from outside the main research sample

Research tests and measurements

The primary measurements:

age to the nearest year-weight to the nearest gram-tall to the nearest centimeter-training age**.**

Measurements of blood and digital level:

- Draw blood samples at rest, place them in glass tubes, and store them in an ice tank, then analyze the blood samples on a flow cytometer to obtain levels of red blood cells, hemoglobin, ferritin, iron, and erythropoietin.
- Measuring the digital level of young women's cross-country racing**.**

data collection Tools and methods:

- The Rasta-meter device for measuring height.
- A calibrated medical scale for measuring weight
- Stopwatch.
- Sterile syringes.
- Ice Tank.
- A form for recording data and measurements of the research sample.
- Medical tubes.
- A flow cytometry device for analyzing samples.
- athletic track

Assistants:

3 assistant coaches were selected from the research sample coaches in the Egyptian athletics national team, and the tests used in the research. (Attachment No. 1).

Exploratory study:

The researchers conducted the exploratory experiment in the period from 1/7/2023 AD to 3/7/2023 on a sample of (4) young women from outside the main research sample, with the aim of:

1. Ensure the safety of the tools used.
2. knowing the mistakes that may appear during the physiological measurements and digital level to avoid them during the primary study.
3. Knowing the timing of training workouts, training load, and rest periods.

The results led to:

- Safety of devices and tools used.
- Assistants understand tests and confirm how to measure and record.
- research sample members' understanding of the exercises used and clear responses to them.

Pre-measurements:

Pre-measurements were conducted in the period from 5-7/7/2023, and then verify the values of the research variables for the sample were confirmed before starting the experiment, as shown in Table (1)

Table (1)
Statistical characterization of the study sample in basic and physiological variables
The digital level is under study. (N = 6)

S	Variables	Measuring Unit	Average	Mediator	Deviation	Skewness
1	Tall	Cm	163.75	164	0.987	-0.760
2	Weight	Kg	52.08	52	0.585	0.428
3	Age	Year	17.22	17.4	0.397	- 1.385
4	Training Age	Year	5.58	5.5	0.584	0.427
5	Red Blood Cells	(Ug/Dl)	4.86	4.76	1.472	0.611
6	Ferritin	Ng/Ml	38.083	39	4.695	-0.586
7	Erythropoietin Hormone	Iu/L	8.66	9	1.505	- 0.664
8	Hemoglobin	G/Dl	12.95	12.7	0.948	0.791
9	Digital Record Level of Cross-Country (6) Km	Min	24.55	24.02	1.056	0.975

It is clear from Table (1) that all the skewness values of the study sample in the basic and physiological variables and the numerical level under study are limited to between -3 and +3, which indicates the moderation of the values for the study sample members before the start of the experiment

Implementation of the primary study:
Implementation of the basic study: The modules of the proposed training program were implemented in the period from 9/7/2023 AD until 27/7/2023 AD on members of the experimental group.

The objective of the proposed tapering peak program:
The proposed program using tapering peak aims to improve the levels of red blood cells, hemoglobin, and ferritin in the blood and the digital level of female cross-country racers.

Foundations of structuring the proposed training program:

1. observance of the principle of variety during implementation exercises in a training session
2. Select the appropriate content for the age group.
3. Follow both the principle of gradation from easy to difficult and the principle from simple to complex.
4. Be guided by the results of previous studies when developing the program.

properties of program contents: Attachment (2):

1. The period for the training program was set for (3) weeks, with (5) training units per week, for a total of (15) training units. (26)
2. Two days of rest have been set (Tuesday - Friday).
3. Use the method of reducing the training load linearly for the experimental group by gradually reducing the volume by 6% for each training unit to reach a reduction of 60% of the volume.
4. Considering the manifestations of stress and fatigue among young girls during performance.

Post-measurements:
post-measurements were conducted from 29-31/7/2023 in the same order and conditions as the pre-measurements.

Statistical processing: The following statistical processing was used:
(arithmetic mean - standard deviation - skewness coefficient - Wilcoxon test - improvement percentage equation)

Presentation and discussion of the results:
First, presentation results:

Table (2)
The significance of the differences between the means of the pre-post measurements after experimenting with the variables of Physiological and digital levels of junior cross-country racers (n=6)

S	Variables	Pre-average	Post-average	Positive ranks		Negative ranks		Value of (y)
				AVE. ranks	Total ranks	AVE. ranks	Toal ranks	
1	Red Blood Cells	4.86	5.34	3.50	21.00	0.00	0.00	2.207
2	Ferritin	38.083	48.83	0.00	0.00	3.50	21.00	2.214
3	Erythropoietin Hormone	8.66	11.67	3.50	21.00	0.00	0.00	2.364
4	Hemoglobin	12.95	13.25	3.50	21.00	0.00	0.00	2.226
5	Digital Record Level of Cross-Country (6) Km	24.55	24.02	0.00	0.00	3.50	21.00	2.201

** The tabulated value of (y) at the level of 0.05 = + 1.96*

It is clear from Table (2) that there are statistically significant differences between the means of the pre-post measurements in favor of the post-measurement at the level of (0.05) in the variables under study.

Table (3)
The percentage of improvement of the experimental group in the physiological variables and digital level of junior cross-country racers

S	*Variables*	*Pre-average*	*Post-average*	*Average differences*	*Percent of improvement*
1	*Red Blood Cells*	*4.86*	*5.34*	*0.48*	*9.88*
2	*Ferritin*	*38.083*	*48.83*	*10.747*	*28.22*
3	*Erythropoietin Hormone*	*8.66*	*11.67*	*3.01*	*34.75*
4	*Hemoglobin*	*12.95*	*13.25*	*0.30*	*2.32*
5	*Digital Record Level of Cross-Country (6) Km*	*24.55*	*24.02*	*0.53*	*2.16*

It is clear from Table (3) that the highest percentage of improvement was for the hormone erythropoietin in the blood, amounting to (34.75%), while the lowest percentage of improvement was in the digital level for cross-country crossing (6 km), amounting to (2.16%) in the research sample.

Figure (1) Significance of the differences between the means of pre- and post-measurements of red blood cells

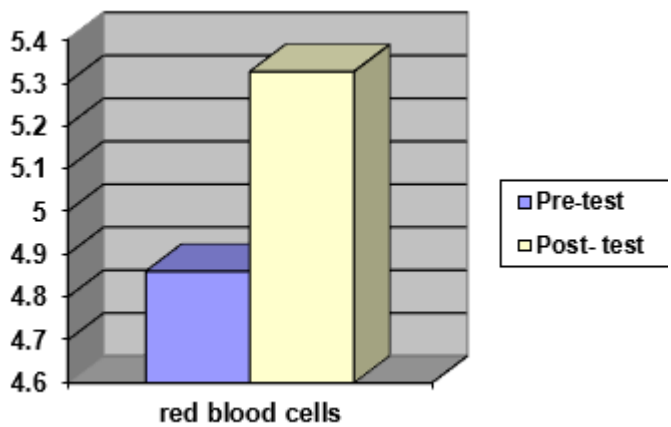


Figure (2) Significance of the differences between the means of pre- and post-measurements of Hemoglobin

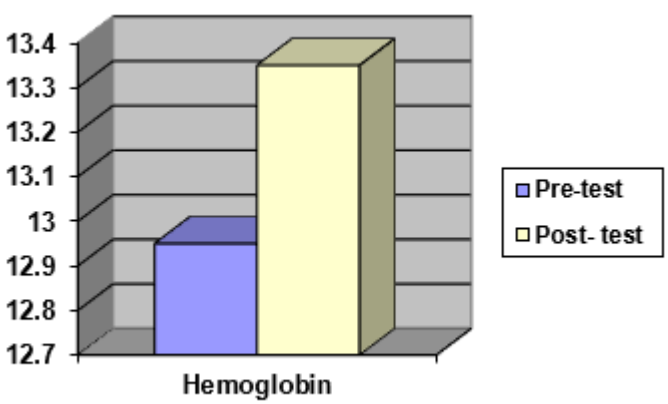


Figure (3) Significance of the differences between the means of the pre- and post-ferritin measurements

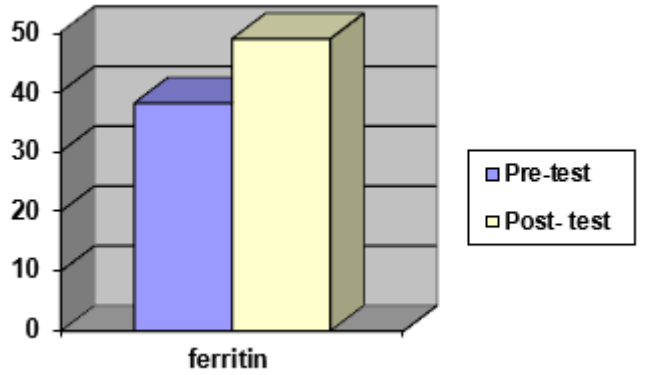


Figure (4) Significance of the differences between the means of the pre- and post-measurements of erythropoietin

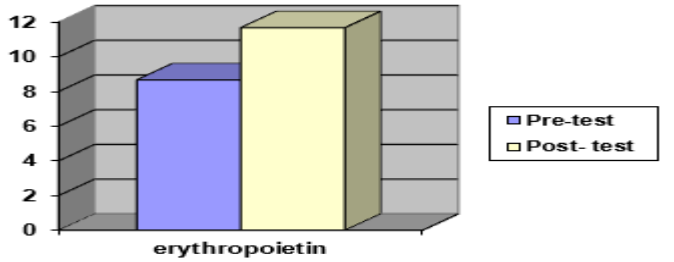
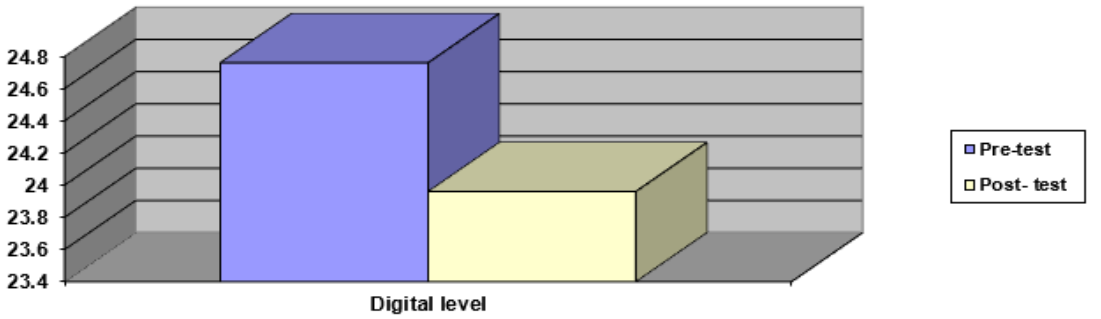


Figure (5) Significance of the differences between the means of the pre- and post-measurements for the digital level



second, a discussion of the results:

Discussion of the results related to the physiological variables of the study sample:

It is clear from Table (2), (3) and Figures (1) (2) (3) (4) that there are statistically significant differences between the pre-and post-measurements of the research sample in favor of the post-measurement in red blood cells, where the arithmetic mean value reached (5.84) by The percentage of improvement was (9.88%), the arithmetic mean value of ferritin was (48.83), as well as the improvement percentage (28.22%), the erythropoietin hormone was the arithmetic mean value of (11.67), as well as the arithmetic percentage of improvement (34.75%), and hemoglobin was the arithmetic mean value of (13.25), as well as the percentage. improvement (2.16%). The researchers attribute this to the fact that the tapering peak using the linear method is considered one of the most appropriate methods that suit the study sample. The researchers took into account when applying the program, the formation of a training environment that works to enable the female players to reach their peak level on the day of the tournament by reducing the amount of training load in a way that does not affect At their levels and also in an attempt to raise the effects of training and increase its effectiveness by reducing the training load before competition (tapering) and the extent of adaptation of the female cross-country athletes under study to this type of training.

This is consistent with what was stated by Mujika et al., (2004) (21) that reducing the training load aims to reduce the physiological and psychological pressures associated

with the training process, improve the individual's athletic performance, and reduce accumulated fatigue without affecting the level of adaptation he has reached. For the player, the best way to achieve this decrease is by maintaining intensity and working to reduce the training load (60-90%). The optimal period ranges between 4-28 days and the performance improvement reaches 3% because of the physiological adaptation of the circulatory and respiratory systems and blood components. The response of the hormonal, nervous, and muscular systems, and the psychological state of athletes.

These results are consistent with what was indicated by Many studies that the body's systems show a set of physiological responses in response to the application of physical loads, and these responses are considered a true indicator. About the physiological and physical condition, and good planning of training programs in a way that ensures that the player reaches his highest level at the right time.

The results of this study are also consistent with what was indicated by both Ziang Wang and others (2023) (26) and Gihad Abdel Mohsen (2014) (11) that tapering is a pre-competition training strategy that gradually reduces the training load to induce optimal athletic performance at the appropriate moment in the season.

Regarding the improvement in the levels of red blood cells, hemoglobin, ferritin, and the hormone erythropoietin, the researchers attribute this to the fact that the program had a positive effect on the physiological adaptation of the study sample, and this is consistent with what was indicated by Greg Wells (2004) (12), and Ed Macneely and David David Sandler (2007) (9), Peeling, P, et al (2008) (23), Burden et al (2015) (7) indicate that reducing the training load (Tapering) increases the concentration Hemoglobin and the increase in the number of red blood cells in athletes through the effect of the hormone erythropoietin, and its benefits may become clear in endurance races.

Discussing the results of the digital level for junior cross country:

It is clear from Table (2), (3), and Figure (5) that there are statistically significant differences between the pre-and post-measurement of the research sample in favor of the post-measurement at the digital level, where the arithmetic mean value reached (24.02), as well as the percentage of improvement (2.16%).

The researchers attribute this to the fact that the training program had a positive impact on physiological adaptation and thus the development of the digital level of the research sample, as many studies indicate that sports training leads to various physiological changes that include almost all body systems.

The level of athletic performance advances whenever these changes are positive, to achieve physiological adaptation of the body's systems to perform the physical load and withstand performance with high efficiency while saving effort.

The results of the study are consistent with the study of Neary et al. (2003) (22), Bosquet, et al. (2007) (6), Ahmed Al-Shafi'i (2010) (2), and Hojatollah et al (2011) (14) that apical calming contributes to improving physiological variables and the level of digital performance.

This is consistent with the results of the studies of Banister, Carter, and Zarkadas (1999) (5), Mujika et al. (2002) (20), Ahmed Al-Shafi'i (2010) (2), and Gihad Abdel Mohsen (2014) (11), which concluded that reducing the training load (Tapering) improves the digital level in many endurance races, including the cross-country race

Conclusion:

Based on the findings and within the limits of the research sample, the researchers were able to reach the following conclusions:

1. tapering peak led to a positive effect on the physiological variables: red blood cells (9.88%), Ferritin (28.22%), erythropoietin (34.75%), and finally hemoglobin (2.32%) in young female cross-country athletes.
2. The tapering peak led to an improvement in the digital level of young female cross-country athletes by (2.16%).

Recommendations:

Considering the research objectives and conclusions, the researchers recommend the following:

1. Using the tapering peak using the linear method in the taper phase before competitions for young female cross-country athletes.
2. Endurance racing coaches pay attention to the tapering peak period in a linear manner while planning the training load.
3. Considering individual differences when applying tapering peak.
4. Conduct a group of research like this study in other individual sports

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