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The Effectiveness of Using the Ultra-Short Race Pace Training (USRPT) Method on Some Physiological and Physical Variables and the Digital Performance Level for Female Students Majoring in Swimming

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الملخص:

يهدف البحث الى معرفة فاعلية طريقة تدريب USRPT على بعض المتغيرات الفسيولوجية والبدنية والمستوى الرقمي لطالبات التخصص في السباحة مستخدمة الباحثه المنهج التجريبي بتصميم المجموعة الواحده مع القياس القبلي والقياس البعدي لملائمته لطبيعه البحث واهدافه ، حيث اشتمل مجتمع البحث على طالبات الفرقه الرابعه تخصص سباحه بكليه التربية الرياضية بنات بالجزيره جامعه حلوان للعام الدراسي 2021 - 2022 وكان عددهم (14 طالبه وقامت الباحثه باختيار عينه البحث بالطريقه العمديه حيث تكونت عينه البحث من طالبات الفرقة الرابعة بكلية التربية الرياضية للبنات بالجزيره وعددهم 14 طالبه بما يمثل 100% من مجتمع البحث للعام الجامعي 2021 - 2022 وقسموا كالتالي عدد (10) طالبات لاجراء التجربة الاساسية وعدد (4) طالبات لاجراء التجربة الاستطلاعية من نفس مجتمع البحث ومن خارج العينة الاساسية ، في ضوء اهداف البحث وفروضه وفي ضوء المنهج الذي تم استخدامه واستنادا الى نتائج البحث والى المعالجات الاحصائيه المستخدمه في قد توصلت الباحثه الى النتائج التاليه:

اثر طريقة تدريب USRPT بشكل ايجابي في المتغيرات الفسيولوجية (ضغط الدم- النبض).

ادى طريقه تدريب USRPT إلى تحسن في المفاءة البدنية (قوة عضلات الذراعين- الرجلين)، كما ادى الى تحسن كبير في المستوى الرقمي.

الكلمات الأفتتاحية : USRPT - المتغيرات الفسيولوجية – المستوى الرقمي.

Abstract:

This research aims to investigate the effectiveness of the Ultra-Short Race Pace Training (USRPT) method on some physiological and physical variables and the digital performance level of female students specializing in swimming. The researcher adopted the experimental method using a one-group design with pre- and post-measurements, as it fits the nature and objectives of the study. The research population consisted of fourth-year students majoring in swimming at the Faculty of Physical Education for

Girls in El-Gezira, Helwan University, for the academic year 2021–2022. The total number was 14 students. The research sample was deliberately selected from the same population, consisting of 14 students, representing 100% of the research population for the academic year 2021–2022. They were divided as follows: 10 students for the main experiment and 4 students for the pilot study, selected from the same population but outside the main sample. In light of the research objectives and hypotheses, the methodology used, and the statistical analyses conducted, the researcher reached the following conclusions: The **USRPT** training method positively affected the physiological variables (blood pressure and pulse rate), improved physical fitness (arm and leg muscle strength), and led to a significant improvement in digital performance.

Keywords: Physiological Variables – Digital Performance – USRPT.

The Effectiveness of Using the Ultra-Short Race Pace Training (USRPT) Method on Some Physiological and Physical Variables and the Digital Performance Level for Female Students Majoring in Swimming

Regular sports training leads to various physiological changes that affect all body systems, particularly cardiovascular and respiratory systems, enabling the body to efficiently handle physical load and achieve optimal performance while saving time and effort. **(Stoian, I. 2007: P81)**

In this regard, Khaled Tamim Al-Hajj (2017) noted that sports training is an effective factor to which the body's vital systems respond. These responses result in several physiological, functional, and psychological changes that enable an athlete to meet the demands of high-performance activities. **(Al-Hajj 2017: P113)**

Fathi Ahmed (2007) clarified that practicing sports greatly affects many vital body systems. The longer the exercise duration, the more the body adapts. Sports contribute to reducing body fat, increasing blood flow through the blood vessels, improving blood pressure levels, enhancing heart efficiency and pulse rate, and increasing vital capacity. For this reason, sports training scientists strive to discover the best modern training methods to raise performance levels, which is the core of the training

process. These efforts reflect the success of training programs in achieving their goals. **(Ahmed 2007: P65)**

Hossam El-Din Farouk (2002) stated that swimming is a competitive sport that has recently witnessed tremendous advancements in digital achievement levels. These improvements result from identifying the best modern training methods that enable easy formation and regulation of physical loads in alignment with the age stage. This alignment positively affects internal body systems, which in turn show a series of physiological responses—such as heart rate and blood pressure—as reactions to applying these loads. These responses are reliable indicators of the athlete's condition during physical activity. **(Farouk Hussein 2002: P39)**

Swimming is considered a sport that requires speed in performance, necessitating high physical capabilities to raise performance levels. Among these capabilities is speed endurance, which helps resist fatigue caused by training and enables energy acquisition through the anaerobic system.
(Al-Qat 2002: P245)

Abou El-Ela Abdel Fattah (2011) indicates that the applications of sports physiology are expanding and becoming more widespread each day. Without a deep understanding of the body's energy production systems, it is difficult to deal with modern training methods, which are primarily based on developing the body's physiological capabilities to produce the energy needed for swimmers' movement in water. Physiological studies have shown that the energy requirements vary between swimming races, which makes it essential for coaches to understand how the human body generates energy for swimming and how the physiological and biochemical processes differ according to the distance of each race. This understanding enables the development of the body's ability to supply the appropriate energy for each race, ultimately leading to new record-breaking achievements. **(Abdallah ‹Ahmed 2013: P56) (Hazem ‹Abo El-Ala 2011: P47)**

The shorter the swimming race, the higher the demand for the anaerobic energy system. This is especially true for events like the 50m, 100m, and 200m races, which last approximately 20–120 seconds. In contrast, longer races like the 800m freestyle rely more heavily on the aerobic energy system. Evidence supporting this is the high blood lactate concentrations measured after races like the 100m and 200m, reaching up to 16–20 mmol/L, indicating a substantial amount of energy derived from anaerobic

glycogen breakdown, resulting in lactic acid accumulation. This highlights the vital role of anaerobic training in enhancing specialization and improving swimmer performance in short-distance events.

(Sharkey 1996: P89)

Maglischo (2013) revisited traditional training approaches during a scientific conference in South Africa, responding to Brent Rushall by proposing a reorganization of training loads. This included training fast-twitch muscle fibers and using speed to develop endurance, thereby ensuring the enhancement of all energy systems engaged during swimming. He emphasized that any trained muscle tissue improves its aerobic capacity regardless of whether the focus is on sprint or endurance training.

Anaerobic capacity, glycogen capacity, and buffering ability in muscle tissues also improve. Maglischo asserted that while muscle fiber types do not change, their functional potential does improve, allowing them to meet performance demands more effectively. **(Maglishco 2013: P18)**

In the past decade, there has been a significant increase in sports science research due to the growing professionalism in sports. As a result, alternati2013: PPPining methodologies have emerged, challenging traditional philosophies. In swimming, where athletes must complete a series of repetitions, this intense effort leads to lactic acid build-up and depletion of glycogen stores, especially toward the end of sets. This results in a decreased glucose supply, leading to diminished performance.

Such declines rarely occur with USRPT training. However, under traditional training, performance may drop unless USRPT is incorporated. One of the strengths of USRPT is its precision—training sets are always performed at race pace, eliminating guesswork around variables like lactate tolerance and aerobic endurance. While certain physiological tests may be applied during training, their correlation with actual race performance remains weak. **(Abo El-Ala 2016: P186)**

In 2011, Professor Brent Rushall defined USRPT training as high-intensity training sets performed at the swimmer's race pace. Once the swimmer adapts to this pace, the speed gradually increased, allowing the swimmer to cover greater distances at target pace. Training sets are designed with very short distances and rest periods not exceeding 20 seconds. **(Abdel Fatah 2016: P211)**

USRPT is also based on Bernoulli's Principle to explain propulsion in water. It demonstrates that drag resistance is the dominant physical force acting against lift, helping swimmers propel forward with greater force during swimming movements.

(Rushall2015:P124)

USRPT is considered the most advanced method globally for training swimmers and achieving record-breaking results. It directly applies the principles of specificity and individual differences. Swimmers repeatedly perform parts of the total race distance at the target pace, with very short rest periods. This allows for maximal high-intensity training that fully matches the physiological demands of the sport and integrates cognitive awareness (mental focus) into every repetition. **(Rushall 2013: P107)**

The training aims to improve both speed and speed endurance—critical components in short-distance swimming events such as 100m, 200m, and 400m. These events depend entirely on fast muscular work, increasing the swimmer's ability to perform at extremely high speed and resist fatigue caused by lactic acid accumulation. This involves activating the anaerobic energy system, specifically through the phosphocreatine (PC) system for very short efforts (under 30 seconds), and glycogen breakdown in the absence of oxygen for longer anaerobic efforts, resulting in lactic acid accumulation. **(Abdel Fatah 2016 : P36-84)**

The USRPT method acts as a buffer against overfatigue, making overtraining rare. However, external factors like poor nutrition, academic pressure, or personal stress can lead to a false state of overtraining even under moderate training intensity
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Scientific research around USRPT shows that record-breaking performances in swimming have greatly improved since the mid-20th century. This progress is attributed to the integration of training with various scientific fields such as physiology and biomechanics. Over time, research has challenged and corrected many outdated beliefs, and modern studies advocate for re-evaluating how energy systems training is applied in swimming.

Based on experience and observation, researchers and coaches in the field of swimming training and exercise physiology have noticed that many coaches tend to increase training volume with long-distance swims and

dryland training that are not aligned with elite swimmer performance. This often negatively impacts performance because swimmers are required to complete all training reps regardless of fatigue level, resulting in lower glycogen stores, higher lactic acid accumulation, and a performance level that is less specific to actual race pace.

Hence, it became necessary to adopt new training methods that suit swimmers' capabilities, consider individual differences, and avoid overloading or underloading athletes. For this reason, the researcher conducted this study to explore the effects of the USRPT training method on physiological, physical, and digital performance variables of female swimmers.

The researcher observed conflicting results in previous studies, particularly regarding heart rate, blood pressure, and some physical variables associated with swimming. These inconsistencies may stem from the continued use of traditional anaerobic training methods. Therefore, the researcher initiated this study to better understand how the USRPT training method impacts these variables, and to uncover accurate, evidence-based information that can guide the selection of the most effective training method

Study Objective:

The aim of this research is to identify the effectiveness of the USRPT (Ultra-Short Race Pace Training) method on:

1. Certain physiological measurements (resting heart rate – post-exercise heart rate – systolic and diastolic blood pressure at rest – systolic and diastolic blood pressure after exercise).
2. Certain physical measurements (arm muscle strength – leg muscle strength).
3. The digital performance level in swimming for distances of 50m and 100m.

Research Hypotheses / Questions:

1. There are statistically significant differences in some physiological variables (resting heart rate – post-exercise heart rate – systolic and diastolic blood pressure at rest – systolic and diastolic blood pressure after exercise) between the pre- and post-tests.

2. There are statistically significant differences in some physical measurements (arm muscle strength – leg muscle strength) between the pre- and post-tests.
3. There are statistically significant differences in the digital performance level in swimming (50m and 100m) between the pre- and post-tests.

Research Terminology:

USRPT (Ultra-Short Race Pace Training):

A training method that involves swimming high intensity sets at a pace equal to the swimmer's race pace, with rest intervals equal to the time of performance**. (Abdel Fattah 2016: P211)**

Blood Pressure:

"The pressure exerted by the flow of blood on the walls of blood vessels, referring specifically to arterial blood pressure." **(Reem‹Maha 2014: P50)**

Heart Rate:

"The rate at which the pressure waves spread from the aortic wall – as blood is ejected from the left ventricle – to the walls of the arteries per minute." **(Nasr El-Din 2014: P123)**

Digital Performance Level:

The overall result that reflects a swimmer's performance level, expressed as the time taken to swim a specific distance. **(AL-Qat 2000: P64)**

Review of Related Studies:

1. **Mohsen & Mohamed Hamdy Khafagy (2021**) – "The effect of a training program using ultra-short sprint training at race speed on improving some physical variables and digital performance in short-distance swimmers."
   The study aimed to examine the effectiveness of a training program based on ultra-short race-pace sprinting to enhance physical variables and performance level. Using the experimental method, a purposive sample of 26 swimmers was selected: 16 for the main sample and 10 for the exploratory one. Results showed improvements in both physical variables and digital performance.
2. **Mona Adel Abdel Fattah** (2020) – "The effect of ultra-short distance speed training on certain functional variables and the level of aerobic and anaerobic endurance in 100m swimmers."
   The aim was to identify the impact of short-distance speed regulation

training on functional variables and endurance levels. The sample consisted of 6 swimmers from Gezira El Ward Club in Mansoura. Results showed improvements in both aerobic and anaerobic endurance and functional variables, as well as digital performance.

3. **Martha Davey (2016)** – "Contribution of blood and respiratory systems in response to ultra-short sprint training." The study aimed to investigate the blood and respiratory system responses to ultra-short sprint pace training. The experimental method was used, and the results indicated statistically significant differences in the variables measured for the group following ultra-short training.
4. **Peter Rattigan (2010)** – "Effectiveness of ultra-short race-pace training on 11–12-year-old female swimmers." The aim was to assess the effectiveness of ultra-short distance pace training in swimmers aged 11–12. The study used the experimental method on a sample of 9 swimmers and showed improvements in digital performance.
5. **William C. & MacMaster (2010)** – "Enhancing blood lactate removal using maximum swimming ultra-short race-pace training." This study aimed to explore how ultra-short race-pace sprint training can enhance lactate removal in the blood. Using an experimental method on a sample of 34 swimmers, results showed statistically significant differences favoring the ultra-short training group compared to traditional training in removing fatigue byproducts and race-induced lactic acid

Research Procedures

First: Research Methodology

The researcher employed the **experimental method** using a **one-group design with pre- and post-measurements**, as it is suitable for the nature of the study.

Second: Research Population

The research population consisted of **fourth-year female students majoring in swimming** at the Faculty of Physical Education for Girls, Al-Jazeera branch – Helwan University, during the academic year **2021–2022**, totaling **14 students**.

Third: Research Sample

The researcher selected the sample intentionally (purposive sampling), comprising **14 fourth-year female students** from the same faculty, representing **100% of the study population** for the academic year 2021–2022. The sample was divided as follows:

- **4 students** were selected to conduct the **pilot study**, from the same population but outside the main sample.
- **10 students** were selected to conduct the **main experiment**.

Fourth: Study Fields

- **Spatial Field:** Faculty of Physical Education for Girls, Al-Jazeera – Helwan University.
- **Temporal Field:** The study was implemented during the period from **March 8, 2022, to May 15, 2022**, for a duration of **8 weeks**, with **2 training sessions per week**.

Sample Selection Criteria:

- All students were newly registered in the fourth academic year (2021–2022).
- All students were within a similar age range, between **20–22 years**.
- All students were **high achievers in swimming** and had passed the **qualifying test** to join the specialization.

Fifth: Sample Homogeneity

The researcher ensured the homogeneity of the sample in terms of age, height, and weight.

Table (1)
Mean, Median, Standard Deviation, and Skewness Coefficient for Growth ariables of the Study Sample

(n = 10)

Variables	Mean	Median	Standard Deviation	Skewness Coefficient
Age (years)	22.2	22.5	0.918	-0.472
Height (cm)	162.9	163	2.13	-0.0963
Weight (kg)	60.4	61	4.99	-1.856

*** Significance level at (p) < 0.05**

*Table (1) shows that the skewness coefficients of the growth variables fall between (+3, -3), indicating a normal distribution of the data.

Table (2)
Mean, Median, Standard Deviation, and Skewness Coefficient for Physiological Variables of the Study Sample
(n = 10)

Variables	Mean	Median	Standard Deviation	Skewness Coefficient
Heart Rate (Pre)	66.739	66	2.49	0.107
Heart Rate (Post)	137	136.5	4.876	-0.014
Systolic Pressure (Rest)	114.8	115	3.614	-0.468
Diastolic Pressure (Rest)	72.5	71	2.99	0.70
Systolic Pressure (Post)	136	135	3.944	-0.407
Diastolic Pressure (Post)	85.4	85	2.988	-0.328

*** Significance level at (p) < 0.05**

*Table (2) shows that the skewness coefficients of the physiological variables fall between (+3, -3), indicating a normal distribution of the data.

Table (3)
Mean, Median, Standard Deviation, and Skewness Coefficient for Physical Variables and Digital Performance of the Study Sample
(n = 10)

Variables	Ean	Median	Standard Deviation	Skewness Coefficient
Arm Muscle Strength (kg)	20.8	20.5	1.751	0.068
Leg Muscle Strength (kg)	21.03	21	0.627	-0.150
Digital Performance – 50m (sec)	39.785	37.71	3.809	1.262
Digital Performance – 100m (min)	1.263	1.225	0.137	0.823

*** Significance level at (p) < 0.05**

*Table (3) shows that the skewness coefficients of the physical and digital performance variables fall between (+3, -3), indicating a normal distribution of the data.

Fifth: Data Collection Tools

The data collection tools used in the study included the following:

1. Tools Related to the Swimming Pool:

- Lane ropes to divide the pool into lanes.
- 4 stopwatches.

2. Devices:

- Swimming pool (25m).
- Rustameter device to measure height in centimeters.
- Medical scale to measure weight in kilograms.
- Dynamometer.
- Blood pressure monitor.

3. Forms:

- A personal data form for each sample participant to record (age – height – weight – anaerobic performance time – leg muscle strength – arm muscle strength).
- Expert opinion form regarding the selected tests (Annex 1).
- Data recording form for the physiological variables of the sample (heart rate – diastolic blood pressure – systolic blood pressure)

4. Tests:

Leg muscle strength test using the dynamometer (Annex 2).
Arm muscle strength test (Modified inclined push-up for girls) (Annex 3).
Digital performance tests for 50m and 100m freestyle:
Performance level was measured by recording the time taken to swim 50m and 100m freestyle.

5. Measurements:

A. Anthropometric Measurements:

Height was measured using the Rustameter to the nearest centimeter.
Weight was measured using the medical scale to the nearest kilogram.

B. Physiological Measurements:

Heart rate.

Systolic and diastolic blood pressure measured using a blood pressure monitor.

Sixth: Pilot Study

The researcher conducted the pilot study on a sample of 4 students from the same population (but outside the main study sample) on Sunday, February 27, 2022, with the aim of:

- Identifying potential challenges, the researcher may face during the implementation of the USRPT method and finding appropriate solutions.
- Assessing the suitability of the intensity and load for the sample participants.
- Evaluating the students' responsiveness and ability to perform the selected exercises.
- Considering individual differences between participants.
- Ensuring safety and security measures during application.
- Anticipating possible difficulties during execution to avoid them.
- Training **2 assistant doctoral researchers** on the correct performance instructions.
- Determining the best order for conducting tests and measurements and calculating appropriate rest periods for recovery

Pilot Study Outcomes:

- Confirmation of the **scientific validity and reliability** of the tests used in the research.
- Verification of the **suitability of the tools and the testing environment**.

Calculating Scientific Measures

1-Validity:

To calculate the **validity** of the test, the researcher used **self-validity** by calculating the **square root of the correlation coefficient** between the first and second applications. This will be presented in **Table (4)**.

2. Reliability:

To assess the **reliability** of the tests, the researcher used the **test-retest method** on a **pilot sample of 4 students** from the same original population (but not part of the main study), matching the characteristics of the study

sample. The time interval between the two tests was **7 days**, with both conducted under the same conditions. Correlation coefficients between the two applications were calculated as indicators of test reliability. These are presented in **Table (4)**

Table (4)
Correlation Coefficients Between the First and Second Applications for Physiological, Physical, and Digital Performance Variables
(n = 4)

Variables	Unit	First Test	Second Test	Correlation Coefficient (r)	Self-Validity
		Mean ± SD	Mean ± SD		
Heart Rate (Pre-exercise)	Bpm	67.250 ± 2.217	59.000 ± 3.916	0.998	0.998
Heart Rate (Post-exercise)	Bpm	133.000 ± 1.633	125.500 ± 4.203	0.971	0.985
Arm Muscle Strength	Kg	21.000 ± 1.414	25.750 ± 1.708	0.966	0.997
Leg Muscle Strength	Kg	21.225 ± 0.591	22.125 ± 0.854	0.983	0.990
50m Freestyle	Sec	37.505 ± 0.248	34.948 ± 0.693	0.958	0.978
100m Freestyle	Min	1.265 ± 0.184	1.148 ± 0.123	0.988	0.993

***Significance at ($p < 0.05$).**
Tabulated R-value = 0.950.
The correlation coefficients range from 0.95 to 0.99, indicating statistically significant reliability.
The self-validity coefficients range from 0.97 to 0.99, confirming the validity of the tests.

Steps for Implementing the USRPT Training Method

- Expert Opinion Survey:

The researcher presented all the tests related to the variables under study to eight (8) experts: four (4) professors from the Physiology Department and four (4) from the Swimming Training Department (see Appendix 1), in order to assess content validity.

The researcher defined the tests and the modern training method (USRPT) in the study, then sought expert opinions. Based on their guidance, some modifications were made, including changing the duration

of the experimental application from six (6) weeks with two sessions per week to eight (8) weeks with two sessions per week.

Based on the researcher's readings, review of previous studies, supervisor feedback, and expert opinions, the measurements, tests, and training methods used in the study were determined as follows:

- The experiment duration was changed from 6 weeks to 8 weeks.
- Training time was gradually increased (increased volume) while maintaining the same high intensity level (90–95%).

The goal of using the USRPT method was to:

1. Improve physiological functions, including systolic and diastolic blood pressure and heart rate.
2. Improve students' performance in freestyle swimming (50m and 100m).
3. Improve arm muscle strength (using modified inclined plank test for girls).
4. Improve leg muscle strength (using a dynamometer, measured in kg).

Variables Under Study:

After reviewing Arabic and foreign scientific references and conducting personal interviews with professionals in the field of swimming training, the researcher designed specific forms related to the variables under study. These were presented to experts with no less than 10 years of experience in the training field. Experts' opinions were considered based on the following criteria:

- Principles for Developing the Training Method:

1. The USRPT method should achieve its intended objectives.
2. The method should be appropriate for the level and capabilities of the sample.
3. Age characteristics should be taken into consideration – as well as individual differences.
4. A suitable training schedule should be set to avoid fatigue or overtraining.
5. Safety and security precautions should be ensured during implementation of the USRPT method.

Both the training schedule and units were presented to a group of experts for evaluation (Appendix 1 includes the names of the experts). Their conclusions were as follows:

A. Training Schedule for the USRPT Method According to Expert Opinions:

- Duration of training: 8 weeks
- Number of training sessions: 16 sessions, at a rate of 2 sessions per week
- Duration of each training session: 90 minutes, divided as shown in the following table:

- **Table (5)**
- **Time Distribution of the Training Unit**

Component	Duration	Description
Warm-Up	10–15 min	General preparation for all body parts.
Main Part	70–75 min	Specific USRPT training drills.
Cool Down	5 min	Relaxation and recovery exercises.

- **Warm-up (10–15 minutes):**

This section aims to provide general preparation for all body parts, stimulate blood circulation, and physiologically and psychologically prepare the participant to handle the training load in the main part of the session, while also preventing injuries. It includes a variety of exercises that target all body parts, large muscle groups, joints, and ligaments. The researcher divided the warm-up into dry-land and water-based warm-up:

- The dry-land warm-up included several exercises (see Appendix 5).
- The water-based warm-up included the four strokes, with varied repetitions.

- **Main part (70–75 minutes):**

This is the core part of the session and includes the exercises under study, specifically using the USRPT training method. The goal is to improve the students' swimming performance as well as heart rate and blood pressure. A sample training session using the USRPT method is provided (see Appendix 5).

- **Cool-down (5–10 minutes):**

  The aim of this section is to help the body and its physiological systems return to their normal state by gradually reducing the training load. It includes muscle stretching exercises, which were performed in the water, either as aquatic-based dry-land exercises or through swimming.

Main Study Implementation Steps

First: Pre-Test Measurements

The pre-test measurements for the research sample were conducted over two days:

- **Day 1**: Physical measurements.
- **Day 2**: Physiological measurements and digital performance.

Tuesday, March 8, 2022:

- The researcher, along with her assistants, gathered the students at the swimming pool of the Faculty of Physical Education for Girls at **8:30 AM**, then moved to the physiology lab at **9:00 AM**.

Physical Measurements Included:

1. **Height, weight, and age** were recorded using the Rustameter.
2. A **5-minute warm-up** with stretches for the arms and legs was performed.
3. **Leg muscle strength** was measured using the dynamometer (kg) – the maximum force exerted by the student was recorded.
4. **Arm muscle strength** was measured using the modified inclined push-up for girls – number of repetitions in one minute.

→ **Rest periods** were given between tests to ensure full readiness for the next.

Physiological Measurements Included:

1. Blood pressure and heart rate at rest were measured using a blood pressure monitor.
2. Students did a **5-minute water warm-up** in the pool.

3. Swam **12 minutes of continuous freestyle**.
4. Blood pressure and heart rate were measured **immediately post-exercise**.

Wednesday, March 9, 2022 – Digital Performance Test:

- At **8:30 AM**, students gathered at the swimming pool, received instructions, and began at **9:00 AM**.

1. Warm-up on land and in water.
2. Students swam **50m and 100m freestyle**; performance time was measured in seconds.

Second: Training Program Implementation

The training program was implemented from **Thursday, March 10, 2022,** to **Thursday, May 13, 2022**, over a period of **8 weeks**, with **2 training sessions per week** on **Tuesdays and Thursdays**, from **9:00 to 11:00 AM** at the swimming pool of the Faculty of Physical Education for Girls.

- Each session started with **land-based warm-up** (Appendix 4).
- Followed by the **USRPT training model** (Appendix 5).
- **Post-Test Measurements**
- The **post-tests** were conducted on **Sunday, May 15, 2022**, using the **same order, tools, assistants, locations, and procedures** as the pre-tests to ensure consistency.

Statistical Treatments Used

The researcher used the SPSS program to compute the following statistical treatments:

- Arithmetic Mean ($\bar{X}$) *Standard Deviation (s) *Skewness Coefficient ($\propto_3$)
- **t-test** for significance of differences ***Normality test**
- **Runs test (Z)** for randomness ***Correlation Coefficient (r)**
- **Improvement Ratios**

Presentation and Discussion of Results

First: Presentation of Results
(...continue with data presentation or tables if available)

Table (6)
Significance of Differences Between Pre- and Post-Test for Some Physiological Variables (n = 10)

Physiological Variables	Unit	Pre-Test Mean±SD	Post-Test Mean±SD	Difference	Z Value	Significance Level
Heart Rate Before Exercise	Bpm	66.739 ± 2.498	60.6 ± 1.897	-6.13	-2.807	0.005
Heart Rate After Exercise	Bpm	137 ± 4.876	128.1 ± 4.841	-8.9	-2.808	0.005
Systolic Pressure at Rest	mmHg	114.8 ± 3.615	104.8 ± 1.814	-9.986	-2.814	0.005
Diastolic Pressure at Rest	mmHg	72.5 ± 2.991	67.5 ± 2.635	-5	-2.555	0.011
Systolic Pressure After Exercise	mmHg	136 ± 3.944	131 ± 130	+5	-3.162	0.002
Diastolic Pressure After Exercise	mmHg	85.4 ± 2.989	81.5 ± 80	+4.3	-2.843	0.004

*** Significance level at (p) < 0.05**

Table (6) shows that the calculated z values using the Wilcoxon test to determine the significance of differences between the pre- and post-measurements of certain physiological variables for the research sample were respectively (-2.807, -2.808, -2.814, -2.555, -3.162, -2.843), with statistically significant p-values less than or equal to 0.05, recorded as. (0.005, 0.005, 0.005, 0.011, 0.002, 0.004), respectively. This indicates that the differences between the pre- and post-measurements are statistically significant and in favor of the post-measurement.

Table (7)
Significance of Differences Between Pre- and Post-Test for Some Physical Variables (n = 10)

Physical Variables	Unit	Pre-Test Mean±SD	Post-Test Mean±SD	Difference	Z Value	Significance Level
Arm Muscle Strength	Kg	20.8 ± 1.751	25.4 ± 1.897	4.6	-2.913	0.005
Leg Muscle Strength	Kg	21.03 ± 0.627	22.01 ± 0.803	0.98	-2.814	0.005

*** Significance level at (p) < 0.05**

Table (7) shows that the calculated z values using the Wilcoxon test to determine the significance of differences between the pre- and post-measurements of certain physical variables for the research sample were (-

3.376, -3.306), with a statistically significant p-value less than or equal to 0.05, recorded as (0.005). This indicates that the differences between the pre- and post-measurements are statistically significant and in favor of the post-measurement.

Table (8)
Significance of Differences Between Pre- and Post-Test in Performance Level (n = 10)

Performance Variables	Unit	Pre-Test Mean±SD	Post-Test Mean±SD	Difference	Z Value	Significance Level
50m Freestyle	Sec	39.785 ± 3.809	36.652 ± 3.882	-3.133	-2.809	0.005
100m Freestyle	Min	1.263 ± 0.137	1.218 ± 0.110	-0.045	-2.825	0.005

*** Significance at (p) < 0.05**

Table (8) shows that the calculated value of (z), using the Wilcoxon test to determine the significance of differences between the pre- and post-measurements of some physical variables among the research sample, reached (-2.809, -2.825), with a significance level less than or equal to (0.05), recorded at (0.005).

This indicates that the differences between the two measurements are statistically significant and in favor of the post-test

Discussion of Results

The results of the study showed statistically significant differences in some of the variables under investigation in a positive direction, while other variables showed significant differences in a negative direction. This prompted the researcher to attempt an interpretation of these results.

Discussion of the First Hypothesis

Hypothesis:

There are statistically significant differences in some physiological variables, namely blood pressure and heart rate, between the pre- and post-tests in favor of the post-test.

The results in **Table (6)** showed that the calculated value of (z), using the Wilcoxon test for significance of differences between the pre- and post-measurements of physiological variables among the research sample, was in favor of the post-measurement.

The researcher attributes this improvement in physiological variables to findings from the studies of Mohamed Sayed Sedky (2019) and Peter Tijan (2015), which agree with Osama Kamel Rateb and Ali Mohamed Zaki (2009), who stated that swimmers who have good levels of oxygen consumption, heart rate, and low levels of lactic acid experience delayed fatigue and improved performance. A swimmer with low resting heart rate and blood pressure is better equipped for the physical demands of training and competition, enabling them to reach desired performance levels.

In Ultra-Short Race Pace Training (USRPT), excessive fatigue is rare due to the method's ability to efficiently supply oxygen to the muscles and enhance phosphagen energy production. During each training interval, oxygen is partially replenished aerobically, while the remaining oxygen debt is met during rest periods. By the final repetition, the reduced need for oxygen enables swimmers to perform optimally under high cardiovascular load. Over time, regular short-distance race-pace training enhances cardiovascular efficiency, lowers resting heart rate, and increases tolerance to intense effort.

According to **Laursen & Jenkins (2010)** and **W. Larry & Jack H. (2015)**, USRPT has long-term positive effects, including improved blood pressure regulation. High-intensity training contributes to reductions in both systolic and diastolic blood pressure by improving cardiovascular efficiency and vascular health. Although temporary blood pressure increases occur during sessions due to exertion, this is a normal physiological response to the increased oxygen demand and performance load.

Discussion of the Second Hypothesis
Hypothesis:
There are statistically significant differences in physical measurements, namely leg muscle strength and arm muscle strength, between the pre- and post-tests in favor of the post-test.

As shown in **Table (7)**, physical improvements are attributed to the USRPT method, which led to significant development in the muscular strength of the legs and arms. These exercises simulate race pace and emphasize improving the specific physical demands of sprint distances—maximum speed, speed endurance, and muscular strength. This, in turn, led to muscular adaptation and more efficient energy use, mirroring the biomechanics of actual races and enhancing performance.

This finding aligns with **Aly Fahmy El-Biek et al. (2008)**, who emphasized the importance of developing speed through speed-strength growth. It also agrees with **Gallishaw (2003)**, who stressed the relevance of kinematic variables as effective performance indicators, which vary among swimmers and influence race times.

The researcher attributes the observed physical improvements to eight weeks of consistent sprint training, which positively affected physical variables due to sustained physical effort and adaptation over time.

This aligns with **Abou El-Ala Abdel Fattah and Brent Rushall (2016)**, who stated that the aim of USRPT is to maximize performance with very short rest intervals, enabling a larger training volume at race pace. This results in physical adaptation occurring faster and more effectively compared to traditional methods, which may lead to overtraining, injuries, or stagnation.

In contrast, USRPT enhances race techniques, including starts, underwater kicking, turns, and other elements critical to speed and performance.

The researcher credits these improvements to the structure and intensity of the USRPT method, which enhances both performance and physical variables due to its focus on high-intensity race-specific repetitions.

Studies by **Abou El-Ala Abdel Fattah & Mohamed Ahmed Abdallah (2013)** and **Islam Abdel Badi (2019)** confirmed that ultra-short race-pace distance training has a positive effect on developing the physical variables in their respective studies.

Discussion of the Third Hypothesis

Hypothesis:

There are statistically significant differences in race performance for 50m freestyle and 100m freestyle between the pre- and post-tests in favor of the post-test.

As shown in **Table (8)**, the results align with **Bahgat Abu Tama'a (2009)**, who emphasized that improving performance depends on physiological adaptation, which enables swimmers to reach peak performance. This requires a training process grounded in a sound understanding of exercise physiology and energy system demands.

Abou El-Ala Abdel Fattah (2011) highlighted that speed endurance is key to reaching elite levels in swimming, as it directly impacts the ability to sustain high speed during both competition and training.

Rushall noted that the concept of modern training (USRPT), developed over 50 years ago, is based on the physiological benefits of high-repetition training with short rest intervals. This method emphasizes technical precision and the integration of energy systems with race-specific movements, making it the only approach that effectively combines technique improvement with energy optimization.

This agrees with the researchers' results, as the USRPT method improved the athletes' performance. The improvement is also attributed to notable increases in arm and leg strength, which are essential components of swimming fitness, especially for effective kicks and strokes during acceleration and propulsion.

These findings also align with **Nariman El-Khatib and Abdel Aziz El-Nemr (2008)**, who confirmed the importance of developing the strength of major muscle groups. Muscular strength enables swimmers to overcome body weight and water resistance, enhancing race performance.

Abou El-Ala Abdel Fattah (2016) also confirmed that training programs of suitable duration that enhance muscular strength and physiological adaptation are the most stable and effective for swimmers—consistent with the findings of this study.

Conclusions

1. The USRPT method had a positive effect on physiological variables (blood pressure and heart rate).
2. The USRPT method significantly improved the digital performance level of the participants.
3. The USRPT method led to improvement in physical efficiency (arm and leg muscle strength).

Recommendations

1. USRPT training should be utilized across various sports activities that require speed.
2. USRPT training should be adopted to improve students' race performance.
3. USRPT training should be integrated into training units due to its positive effects on recovery speed.

4. Additional studies should be conducted on different performance levels and across different swimming events.

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