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Effect Of Functional Training On Some Anaerobic Metabolic Enzymes, Biokinetic Variables And Rising Punch Strength In Emerging Boxers

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Abstrak

In this study, an important issue in the field of exercise training physiology and biomechanics is highlighted. The aim of this study is to determine the real effects of functional training on improvement of the efficiency of anaerobic metabolic enzymes (CPK and LDH), biomotor variables and increase of punch power in young boxers. To achieve these objectives the investigator used the experimental method by establishing two equivalent groups (experimental and control). A purposive sample of 10 adolescent boxers (15-16 years old) were selected from Hilla Sports Club and randomly allocated into two equal groups to maintain balance for the research. During the eight weeks leading up to the actual experiment, the experimental group followed a rigorous and consistent functional training program, consisting of three training sessions per week. The procedures included the collection of intravenous blood samples for the analysis of enzymatic markers and the performance of physical assessments, which consisted of measuring the explosive strength of the upper limbs through the throwing of a 3 kg medical ball, evaluating motor velocity through the repeated punching in 10 seconds, and quantifying the force of the upward punch in Newtons with precise scientific equipment. The field experiment demonstrated significant statistical results with marked benefit for the experimental group relative to the control group using conventional training methods for all physiological, physical and mechanical features. The study posted impressive “impact size” numbers of 2.6 to 3.8. According to the data, the researcher made a strong scientific conclusion that functional training can improve neuromuscular coordination and induce good physiological changes in cells, so as to greatly increase the absolute force of the upward punch, and improve the energy transfer efficiency of the human body's open kinetic chain.

Keywords: Functional Training, Anaerobic Metabolic Enzymes, Biokinetic Variables, Rising Punch Strength, Emerging Boxers.

INTRODUCTION

Modern boxing is characterised by rapid progress in training techniques aimed at improving the physical, physiological and skill performance of athletes (Ilhomovich, 2022). The future champions are based on the new boxers. Therefore, the application of modern training methods is necessary, focusing on biochemical and physical changes, which are necessary for competitive bouts (Arman, 2024). In this regard, functional training is becoming increasingly popular as one of the best options, focusing on the improvement of complex movements that mimic real-life actions in competitive environments (Liu et al., 2024). This involves the activation of both the large and small muscle groups which play a vital part in body stabilisation and force application (Beattie & Ruddock, 2022). Boxing requires various skills and competencies as it involves dealing with different situations that require quick responses and effective handling of unexpected situations that a player may encounter (Mahlangu et al., 2024; Kasim, 2022).

Functional training involves not only physical and skill aspects, but also induces profound changes in muscle cells, such as in the activities of anaerobic metabolic enzymes like CK and LDH, speeding up the synthesis of high-energy phosphorus compounds, and modulating anaerobic glycolysis pathways to mitigate fatigue (Xia et al., 2024). Biochemical gains achieved through vocational training contribute to increasing the basic biodynamic parameters of a boxer, such as explosive strength, speed and velocity power, which are important for the implementation of offensive and defensive techniques (Zhang & Cheng, 2022). Training develops both closed and open kinetic chains; the upward punch, for example, requires a smooth transmission of force throughout the body (Dunn et al., 2022). The usual gap is not enough to evaluate the efficiency of training programs, since the effect size is the most precise criterion to assess the impact of functional training on specific enzymes, motor variables and complex skills, such as the upward punch in novice boxers (Adil, & Kasim, 2026; Zhang et al., 2024).

Functional training is important because it involves several muscle groups at the same time, which simulates real action in the ring and improves motor links. The purpose of the study is to emphasise the effect of functional training on biomotor parameters, punching power and adaptation of anaerobic metabolic enzymes such as LDH and CPK in young athletes, providing a scientific basis for coaches for the development of more effective training programs. Boxing is a discipline that requires high-intensity anaerobic effort, with the need to react quickly to offensive and defensive situations in a short period of time (Venckunas et al., 2024). The uppercut is an easy offensive technique that requires a certain sequence of movements and smooth transference of power from the torso and legs to the arm used for striking (Omcirk, 2023). The field experience and scientific observations of the researchers show that many novice boxers cannot maintain the power and accuracy of their upper-cut punch during the fight, as well as the delayed reaction of the related biokinetic variables. This is often the result of relying on traditional training methods that do not include biochemical processes and do not build complex and realistic kinetic models.

The increase in anaerobic work places a large demand on the enzymes that support anaerobic metabolism such as CK and LDH, which allow for rapid energy production and regulation of intramuscular dynamics (MacLaren & Morton, 2024). The application of contemporary training methods such as functional training, which emphasises training of the open and closed motor chains and the involvement of auxiliary and antagonistic muscles, generates an imbalance in biochemical and physical adaptation and negatively impacts the biomotor variables necessary for the strength of skill performance (Xiong & Thadanatthaphak, 2024). Several previous studies have indicated the common "statistical significance" of training programs without evaluating the real-world effectiveness of the achieved modifications, thus raising a scientific question about the job training effectiveness (Borg et al., 2023; Zhang et al., 2026).

The objective of this study is to identify the extent of the impact of job training on the modification and enhancement of enzymes related to anaerobic metabolism and the effect on the improvement of biodynamic variables and upper punch strength in novice boxers, through a strict scientific methodology that provides objective evidence and indicators for trainers of this segment of athletes. "A lot of the training regimes provided to potential boxers are based on traditional strength training which may not necessarily improve neuromuscular coordination or optimise anaerobic energy production," commented the researcher, who is an international and academic boxing referee. This difference causes energy loss and reduction of explosive power of the upward punch. Therefore, improved physical and functional efficiency is required. The study has been designed to determine the effect of functional training on the increase of the efficiency of anaerobic metabolic enzymes, biomotor variables and the force of vertical punch in novice boxers.

This study aims to develop and implement a functional training program specifically designed for junior boxers. It further seeks to examine the differences between the pre-test and post-test results of both the control and experimental groups across the studied variables, including anaerobic metabolic enzymes, biomotor abilities, and upward punch strength. Additionally, the study aims to determine the magnitude of the effect of functional training on these physiological and performance-related variables by calculating the effect size, thereby providing a comprehensive evaluation of the effectiveness of the training program.

It is hypothesized that there will be statistically significant differences between the pre-test and post-test measurements of both the control and experimental groups, with the post-test results demonstrating superior performance. Furthermore, it is hypothesized that functional training will produce a significant positive effect on improving physiological markers related to anaerobic metabolism, biomotor variables, and upward punch strength, with the experimental group showing greater improvements than the control group.

RESEARCH METHODOLOGY

The study employed an experimental research design using two equivalent groups, namely a control group and an experimental group, with pre-test and post-test measurements to ensure consistency with the research problem and objectives. The research population was identical to the study sample, as a total sampling technique was applied. The sample consisted of 10 junior boxers from Hilla Club, who were randomly assigned into two equal groups of five athletes each. This design enabled the researcher to compare the effects of the functional training program on physiological and performance variables while controlling for potential confounding factors.

Data collection was carried out using direct observation and supported by relevant scientific references and literature. The equipment and materials used included medical syringes manufactured in China, a cotton bag, German-manufactured sterilization alcohol, laboratory blood collection tubes containing anticoagulants, a blood sample separation device, a German medical weighing scale, a German electric medical refrigerator for preserving blood samples, a boxing punching bag, and 10-ounce boxing gloves. These instruments were utilized to collect physiological data, monitor participant characteristics, and conduct the physical performance tests required for the study.

Sample Homogeneity

The uniformity of the sample was assessed across several factors (height, weight, age, training age), as illustrated in Table (1).

Table 1: Shows The Homogeneity Of The Research Sample.

Variables	Unit of Measurement	M	SD	Torsion coefficient	Preview error
Age	Year	15.44	0.84	0.62	0.81

Length	Cm	169.50	3.20	0.25	0.65
Weight	Kg	58.42	1.15	0.23	0.62
Training Age	Year	2.11	1.20	0.59	0.71

Table 1 indicates that all study variables met the assumptions of homogeneity and normal distribution, as evidenced by the absence of significant differences among participants and acceptable measures of skewness. Data collection involved standardized assessments and professional evaluation forms, supported by participant record sheets, a punch force measurement device, a rotational testing apparatus, a spectroscopic analyzer, a digital medical scale with an integrated height meter, and a laptop for data processing. Based on a review of relevant literature and the objectives of the study, the variables investigated included anaerobic metabolic enzymes (creatine phosphokinase [CPK] and lactate dehydrogenase [LDH]), biomotor variables (arm explosive power and movement speed), and upward punch strength. Prior to the main experiment, a pilot study was conducted on February 23, 2026, to evaluate the functionality of the equipment, estimate the testing duration (approximately 15–20 minutes per boxer), and ensure the readiness of the research assistants. A test–retest procedure was subsequently performed on March 1, 2026, to establish the reliability and stability of the measurement instruments before the pre-test phase.

The validity of the measurements was established through expert judgment involving specialists in sports training and exercise physiology. Ten experts evaluated the suitability of each test for measuring the targeted biomotor and physiological variables, while the instruments used to assess upward punch strength and biochemical markers were standardized measurement tools. The level of expert agreement was statistically verified using the chi-square goodness-of-fit test, confirming the appropriateness of the selected assessments for the study.

Table 2: Show honesty through expert opinions about the validity of the tests used in the research.

Test Name	**Variable Scaled**	**Agree**	**Disagree**	**Percentage of agreement**	**Calculated value ($\chi 2$)**
Drop 3 kg medical ball	Explosive power of the arms	10	0	100%	10.00
Continuous punching 10 s	Kinetic speed	9	1	90%	6.40

Reliability of Tests

The reliability of the measurement instruments was established using the test–retest method. The initial assessments were conducted on the 10 boxers included in the pilot sample on February 23, 2026, and the same tests were repeated under identical environmental and testing conditions on March 1, 2026, with a seven-day interval between assessments. The stability of the measurements was determined by calculating Pearson's product–moment correlation coefficient between the scores obtained from the first and second tests. To ensure objectivity, particularly for assessments requiring accurate timing and scoring, two independent evaluators simultaneously recorded the performance of each participant. The use of independent raters minimized observer bias and enhanced the consistency and credibility of the collected data.

Table 3: Shows the consistency and objectivity coefficients of the tests used in the research.

Tests Name	Unit of Measurement	Stability coefficient (t)	Objectivity coefficient (t)	Statistical Evaluation
Explosive power of the arms (throwing a 3 kg ball)	Meter	0.89	0.91	Consistency and high objectivity
Bearing speed (30 seconds max speed)	Punch	0.91	0.90	Consistency and high objectivity

The table indicates that the stability levels fluctuated between 0.89 and 0.91. The elevated levels of consistency can be attributed to the precision of the test standardisation and their appropriateness for the age and physical condition of young boxers, while the objectivity of the data indicated exceptionally high values ranging from 0.91 to 0.90.

RESULT AND DISCUSSING

The pre-tests for both groups were carried out on March 3, 2026, under standardised spatial and temporal conditions. To guarantee the comparability of the two research cohorts, the sample was randomly allocated into two groups (experimental and control), each comprising ten boxers; the researcher needed to confirm the equivalence of both groups at the outset (pre-tests) concerning biodynamic variables and performance endurance. The T-test was employed for the independent samples to confirm the absence of significant differences prior to the commencement of the experiment.

Table 4: Shows the arithmetic medians, standard deviations, and the value of (v) calculated for the pre-tests between the experimental and control groups (equivalence).

Variables	Unit of Measurement	Experimental		Control		T	Sig
		M	SD	M	SD		
Enzyme (CPK)	IU/L	162.4	12.15	165.10	11.8	0.841	0.412
Enzyme (LDH)	IU/L	185.3	15.42	182.90	14.6	0.765	0.455
Throwing a medical ball	Cm	412.5	18,20	415.00	17.5	0.652	0.523
Punching Speed	Punch	48.20	3.10	47.80	3.40	0.548	0.591
Bullish punch power	Newton	1150.6	85.3	1165.2	90.1	0.702	0.493

The computed values of (v) were (0.25, 0.22, and 0.28) correspondingly. Given that all computed values fall below the tabulated value of (T) at (2.10) with 18 degrees of freedom and a significance threshold of (0.05), this statistically demonstrates the absence of significant differences between the two groups. This equivalence in preliminary assessments guarantees that the trial commences from a uniform baseline.

Training Curriculum

The training program was created from contemporary scientific literature on training physiology, tailored to the age and physical attributes of the study group (young boxers aged 15-16). The syllabus focused on anaerobic metabolic enzymes and their influence on biomotor abilities and vertical punch power via vocational training to enhance the physical and technical prowess of the novice boxer. The functional training program is tailored to accommodate the physiological and physical attributes of adolescent boxers aged 15 to 16, based on the subsequent factors: The functional training program was implemented during the special preparation period and lasted for eight consecutive weeks. Participants completed three training sessions per week, conducted on Saturdays, Mondays, and Wednesdays at Hilla Sports Club, resulting in a total of 24 training units. Each training session lasted approximately 90 minutes. To optimize training adaptation while minimizing the risk of overtraining, the program followed a 3:1 load periodization model, consisting of three weeks of progressively high training loads followed by one week of reduced training intensity for active recovery. This structured progression ensured adequate physiological adaptation and maintained the athletes' readiness throughout the intervention period.

Following completion of the intervention program, post-test assessments were conducted on May 3, 2026, under the same environmental conditions, testing procedures, and protocols used during the pre-test to ensure the accuracy and comparability of the results. The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including the arithmetic mean, standard deviation, skewness, and standard error, were calculated, while inferential analyses included paired-samples *t*-tests to examine within-group changes and independent-samples *t*-tests to compare differences between the experimental and control groups. The results focused on changes in physiological (anaerobic metabolic enzymes), biomotor, and performance variables. To determine the significance of differences between the pre-test and post-test scores of both groups, the researcher calculated the arithmetic means, standard deviations, and corresponding *t*-values, with the findings summarized in Table.

Table 5: Shows the arithmetic media, standard deviations, calculated t-value, and significance level for the pre- and post-tests and for the two groups (experimental and control) in all research variables.

Variables	Unit of Measurement	Groups	M	SD	M	SD	T	Sig	Impact size (d)
Phosphocreatine kinase (CPK)	IU/L	Experimental	162.40	12.15	198.60	10.50	8.75	0.000	3.1 (Extra Large)
		Control	165.10	11.80	167.50	11.20	1.85	0.082	-
Lactate dehydrogenase (LDH)enzyme	IU/L	Experimental	185.30	15.42	225.40	12.30	7.92	0.000	2.8 (Extra Large)
		Control	182.90	14.60	185.10	13.90	1.62	0.114	-
Explosive power of the arms (throwing a medical ball)	Cm	Experimental	412.50	18.20	455.80	14.10	9.41	0.000	2.6 (Extra Large)
		Control	415.00	17.50	419.50	16.80	2.41	0.045	0.25 (Small)
Motor speed of the arms (continuous punching)	Punch	Experimental	48.20	3.10	59.50	2.90	10.12	0.000	3.8 (Extra Large)
		Control	47.80	3.40	49.10	3.20	2.05	0.051	-
Rising Punch Force (Mechanical Variable)	Newton	Experimental	1150.60	85.30	1380.30	70.20	11.05	0.000	2.9 (Extra Large)
		Control	1165.20	90.10	1180.50	88.40	2.31	0.038	0.17 (minor)

The researcher found that anaerobic metabolic enzymes (CPK and LDH) demonstrated a statistically significant physiological change in the experimental group, as the average of (CPK) escalated from (162.40) to (198.60 IU/L) with a t-value of (8.75), and (LDH) rose from (185.30) to (225.40 IU/L) with a t-value of (7.92), reaching a significance level of (0.000). In contrast, the control group demonstrated a slight physiological standstill, as the differences did not attain significance, registering (Sig = 0.082) for CPK and (0.114) for LDH, which are above (0.05). It realised a considerable enhancement in the motor velocity of the arms, reaching (59.50 punches) with a value of (t = 10.12). In contrast, the control group's progress in explosive force was restricted to a dimensional mean of (419.50 cm) with a t-value of (2.14), and its kinetic speed did not exceed the stable moral threshold of (49.10 punches), showing a non-significant significance of (0.051).

The rising punch of the experimental group showed a significant increase in the mechanical force with an average of (1380.40 N) compared to the previous (1150.60 N). The largest value of (t) in the study was (11.05) at a significance level of (0.000). On the contrary, the development of the control group occurred in a linear and slow way and while it constituted a minimum statistical function (Sig = 0.038), its absolute value was clearly insufficient at a dimensional mean of (1180.50 N). Values that correlate with "very large impact" in terms of physical, physiological and mechanical factors demonstrate the considerable developmental potential of the proposed career curriculum compared to the typical program.

Table 6: Shows the arithmetic media, standard deviations, the value of (t) and the level of significance of the post-tests between the control and experimental groups.

Variables	Unit of Measurement	Experimental		Control		T	Sig
		M	SD	M	SD		
Enzyme (CPK)	IU/L	198.60	10.50	167.50	11.20	6.45	0.001
Enzyme(LDH)	IU/L	225.40	12.30	185.10	13.90	5.88	0.002
Throwing a medical ball	Cm	455.80	14.10	419.50	16.80	5.12	0.003
Punching Speed	Punch	59.50	2.80	49.10	3.20	7.34	0.000
Bullish punch power	Newton	1380.40	70.20	1180.50	88.40	6.95	0.001

The results of the telemetry showed that the experimental group was significantly better than the control group. The anaerobic metabolic enzymes CPK and LDH were significantly better in the experimental group. The CPK enzyme had a mean value of 198.60 IU/L in the experimental group and 167.50 IU/L in the control group with a t-value of 6.45. The level of LDH enzyme in the experimental group was 225.40 IU/L and in the control group was 185.10 IU/L with t-value 5.88. Both metrics are significant at the (0.05 Sig/leq) level confirming the effectiveness of functional training in improving anaerobic cellular adaptations.The experimental group had a better explosive power in the arm with an average of (455.80 cm) than the control group with an average of (419.50 cm) with t-value (5.12). In the motor speed assessment, the experimental group (59.50 punches) scored significantly better than the control group (49.10 punches) with a t-value of (7.34) at a significance level of (0.000), which suggests better neuromuscular coordination and rapid fibre recruitment.The strength of the upward punch (mechanical variable) greatly improved the force of the experimental group with an average measurement of (1380.40 N) compared to the control group that reached (1180.50 N) resulting in a t-value of (6.95) indicating statistical significance at the (0.001) level. The difference proves the effectiveness of the career strategy quantitatively.

DISCUSSION

The statistical results showed an unprecedented significant increase in the enzymatic activity of phosphocreatine kinase (CPK) and lactate dehydrogenase (LDH) in the experimental group during telemetry. The investigator attributes the marked rise in CPK to the nature of the physiological stimulus provided by the carefully designed functional training stations and short periods of exertion (phosphate system). Introducing the fledgling boxer to this anaerobic exertion compels muscle cells to enhance the synthesis of CPK in the cytoplasm to expedite the regeneration of adenosine triphosphate (ATP). Anderson and Drust (2023) emphasise that training programs focused on high-intensity anaerobic systems elicit essential cellular enzymatic changes that allow muscles to sustain explosive power output. With regard to LDH activity, circuit training featuring insufficient rest intervals subjects the muscles to the demands of the anaerobic glycolysis pathway, hence enhancing the efficacy of LDH in processing pyruvate and transforming it into lactate (Wang et al., 2025).

This discovery aligns with the results of a research by Lee et al. (2023) on martial arts athletes, which verified that specialised functional training concurrently enhances anaerobic enzymatic reserves. endowing the athlete with metabolic capability that allows him to sustain elevated-intensity offensive exertion without a precipitous decline in effectiveness. Subsequent evaluations revealed a considerable ethical advantage and greater archaeological dimensions for the experimental cohort in the medical ball throwing assessment and the sustained punching frequency. This advancement is elucidated in the "neuromuscular adaptations" that arise from functional training. Functional training is not about muscles, it's about movement patterns. Fighting ropes or throwing medicine balls makes the central nervous system send out nerve fluids to recruit the maximum number of fast-twitch fibres (Type IIb). This synchronisation leads to a faster rate of strength progression. This is supported by Boyle's training reference Wang et al. (2023); and Salih, Hashim, and Kasim (2021) which states functional training increases the efficiency of coordination within individual muscles and between muscle groups, allowing the athlete to release maximum potential energy in the least amount of time. The researcher said the significant increase in arm motor speed (59.50 punches) is due to the reduction of the occurrence of opposing nerve induction and the decrease of muscle tissue viscosity, which allows a rapid succession of punches without premature stiffness.

This analysis is consistent with the statement of Correia (2025) that the increase of maximum motor velocities is closely related to the efficiency and speed of the coordination of the neural impulses sent by the brain to the targeted muscles. The experimental cohort's result of increasing the upward punch force (1380.40 N) is the actual mechanical peak of neuromuscular coordination. From a biomechanical point of view, the upward punch obeys the rule of an open "kinetic chain". The strength of this strike comes from the "ground reaction force" which is transmitted through the knees, pelvis and core muscles, adding to the grip. The functional routine concentrated on trunk stability exercises combined with explosive strength so the core becomes a solid mechanical conduit, transferring kinetic energy efficiently.

CONCLUSIONS

The findings of this study demonstrate that the functional training program produced substantial improvements in the physiological and performance characteristics of junior boxers. Significant increases in the activity of the anaerobic metabolic enzymes creatine phosphokinase (CPK) and lactate dehydrogenase (LDH) indicate enhanced adaptation of the phosphagen and glycolytic energy systems. The program also resulted in marked improvements in biomotor performance, particularly in arm explosive power and maximum punching speed, reflecting enhanced neuromuscular coordination and more efficient recruitment of fast-twitch motor units. Furthermore, functional training significantly increased uppercut punch force, measured in newtons, by improving core stability and optimizing the efficiency of the kinetic chain, thereby facilitating more effective transfer of ground reaction forces during punching. In contrast, the conventional training program applied to the control group produced only minor improvements in selected physical performance measures and failed to induce meaningful physiological, enzymatic, or biomechanical adaptations.

RECOMMENDATIONS

Based on the findings of this study, it is recommended that functional training be incorporated as a fundamental component of physical and technical preparation programs for junior boxers, particularly during the specialized preparation phase, as an alternative to traditional strength training that primarily emphasizes isolated muscle development. Boxing coaches should prioritize functional exercises that closely replicate punching mechanics, such as kettlebell drills, medicine ball exercises, and elastic resistance training, to simultaneously enhance explosive power and movement coordination. In addition, boxing clubs and training institutions are encouraged to conduct regular biochemical assessments, particularly of creatine phosphokinase (CPK) and lactate dehydrogenase (LDH) activity, to monitor athletes' physiological adaptation and use these indicators to optimize training loads while minimizing the risk of overtraining. Training programs should also place greater emphasis on strengthening the core, abdominal, and trunk muscles, as these structures are essential for efficient force transmission through the kinetic chain during punching movements. Finally, future research is recommended to investigate the effects of functional training on other punching techniques, such as the hook and straight punch, as well as its effectiveness across different age groups, including children and young adult boxers.

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Appendix (1) Description of Research Tests

Accurate Characterization of Search Test Procedures and Protocols
Physiological measurements of anaerobic metabolic enzymes (CPK) and LDH (Brancaccio et al., 2010, p. 759)

- **Assay Name:** Serum measurement of serum concentration of creatine phosphokinase and lactate dehydrogenase (LDH).
- **Objective:** To monitor the cellular physiological adaptations and efficiency capacity of anaerobic energy production systems (phosphate and lactic) according to the independent variable.
- **Instruments & Devices:** Disposable Sterile Medical Syringes (5 ml capacity), Dry Anticoagulant Free Chemical Test Tubes (Gel & Clot Activator), Sterile Alcohol Swabs, Mobile Cooling Box, Centrifuge with Adjustable Cycle Speed, Chemical Automated Spectrophotometer.

Description:

1. The budding boxer is required to fast completely from food and drink (except water) for a period of (10-12 hours) before the date of the draw, while avoiding any violent physical effort 24 hours before the examination to ensure the stability of musculoskeletal indicators.
2. The pull-out takes place at 8:00 a.m. (8:00 a.m.) when the boxers are fully rested and seated stable.
3. A specialized medical staff sterilizes the elbow area, then draws an intravenous blood sample (3-5 ml) from the medial cubital vein.
4. Samples are transported directly into an ice-lined cooling case to the analytical laboratory to prevent breakdown of red blood cells that may impair the accuracy of enzyme readings.
5. The tubes are left for 15 minutes at room temperature to coagulate, then placed in a centrifuge at a speed of (3000 rpm) for (10 minutes) to separate the serum.
6. The purified serum is drawn by a micropipette and analyzed via a chemical spectroscopy to extract the values of concentrations in the International Unit of Measurement (IU/L).

TESTS FOR BIODYNAMIC VARIABLES

First: Testing the explosive power of the arms (throwing a medical ball weighing 3 kg from sitting) (Hassanein, 2020, p. 318).

- **The objective of the test:** to measure the maximum explosive capacity of the muscles of the arms and shoulder girdle in the shortest possible time.
- **Tools used:** Metered weight (3 kg), sturdy wooden chair with vertical backrest free of side rests, non-stretchable metric tape, soft chalk powder to pinpoint the drop point.

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Description:

1. The budding boxer sits in the chair with a straight torso, with his back and butt fully in contact with the backrest, and the feet fully apart and stable on the floor (to isolate the efficiency of the leg thrust or torso ripple and focus entirely on the arm thrust).
2. The boxer holds the medical ball with both hands, and places it next to the chest just below the chin.
3. Upon hearing the start signal, the boxer pushes (throws) the medical ball forward and up at an approximate flight angle (40-45 degrees) and with maximum explosive force and speed (Hassanein, 2020, p. 318).
4. Each boxer is given 3 consecutive attempts, and a rest of (a full minute) is required between each attempt to ensure the rebuilding of the high-density phosphate energy complex (ATP) within the muscles .

Scoring method: The horizontal distance from the front edge of the base of the chair to the nearest point where the ball made a mark on the ground is measured by a tape measure, and the result is recorded to the nearest centimeter, with the best (farthest) attempt of the three attempts based on the final results.

Second: Arms motor speed test (the speed of continuous motor performance of the arms within 10 seconds) (Chaabene et al., 2015, p. 1146).

- **Objective of the test:** To measure the maximum motor speed limit and the sequence of rapid muscle contractions of the upper extremities characteristic of boxing.
- **Tools used:** Suspended and stable boxing bag (weight 40 kg), legal boxing gloves matching the junior category, digital electronic stopwatch that reads to the nearest millisecond of a second, referee whistle.

Description:

1. A clear square or circular mark with a diameter of (30 cm) is drawn in chalk on the boxing bag, and adjusted to the height of the boxer's head while standing.
2. The boxer stands at a reasonable distance that allows him to extend his entire arm when punching.
3. Upon hearing the whistle, the boxer begins to direct a successive and continuous series of straight punches (left and right alternately) at the maximum possible kinetic speed towards the mark marked on the bag
4. The performance continues with a maximum rush of a strictly defined time period (10 seconds) and then the whistle stops.
5. The boxer is given only two (2) attempts, separated by a mandatory rest time of (3 full minutes) to ensure that the muscle acidity is partially eliminated and fatigue does not affect the second attempt (Chaabene et al., 2015, p. 1146).

Method of Recording: The researcher and his assistants after the correct punches that meet the motor conditions and hit the target within the time of 10 seconds, and the result of the highest number of attempts is recorded and approved.

Mechanical/Skill Variable Test (Rising Punch Strength) (Cheraghi. 2014, p. 53).

- **Objective of the test:** To measure the efficiency and digital kinetic output (mechanical power in newtons) of the uppercut.
- **Tools and Devices:** A Dynamometer connected to a wall goal pad or a dedicated boxing bag, equipped with precision pressure sensors (Load Cells) or digital accelerometers linked to an electronic processing unit and a digital display to display instant results.

Description:

1. Adjusts the height of the electronic target pad to perfectly match the anthropometric measurements and height of the emerging boxer, to simulate directing the upward punch towards a hypothetical opponent's chin area in a field fight.
2. The boxer stands in full standby and, when fully prepared, takes the correct mechanical path of the upward punch: (slightly bending the knees, rapid torsional rotation of the torso of the torso and transfer the force from the feet upwards) and then hits the target with the strong (characteristic) arm with its maximum mechanical explosive force (Cheraghi et al., 2014, p. 53).
3. The boxer (3) is given valid and independent attempts, and a break period of (two full minutes) is required between attempts to ensure the complete replenishment of the nerve and phosphoric stores of the fast muscle fibers (Turner et al., 2011, p. 5).

Recording method: The digital reading of the perceived impact intensity is monitored directly on the screen of the device in Newton units or kilograms/force, and the researcher records the highest (best) reading among the three attempts of the sample members.

Appendix (2)

Daily Training Module Plan Template (Job Training Method)

- **The goal of the unit:** to develop the explosive force and kinetic speed of the arms, and to increase the mechanical strength of the ascending punch, while stimulating anaerobic metabolic enzymes (CPK, LDH).
- **Target Audience:** Junior Boxers (15-16 years old).
- **Total unit time:** 90 minutes.

Module Sections	Performance Content and Exercises Applied	Approved intensity	Working Time	Interstitial rest time	Repetition and combinations
Preparatory Section [15 min]	Light jogging around the ring, and light jumping exercises with the rope. Flexibility and animated stretching exercises for the shoulder, torso, and knee joints, followed by imaginative movements in the vacuum	Low-to-medium gradient	15 minutes total	None	Continuous and codified repetition
Main Section [60 min]	Throw a medical ball (3 kg) from bottom to top with both hands with maximum explosive force that mimics the movement of an .upward punch	95% - 100%	15 seconds	45 seconds	4 Sets (Rest between round sets: 3 minutes)
	The kettlebell swings with an appropriate weight from the feet to chest level with a focus on the explosive contraction of the pelvic and back .muscles	85% - 90%	20 seconds	40 seconds	4 Sets
	Hit the double combat ropes with quick and powerful ripples with both arms while maintaining .standby stability	100%	15 seconds	45 seconds	4 Sets
	Consecutive fast	95% -	10	50 seconds	4 Sets

	upward punching performance against the resistance of the dynamic rubber ropes installed .behind the back	100%	seconds		
	Wide jump from the standstill forward then a direct landing in a squat position and instant rebound to direct an upward punch towards a .target airbag	90%	15 seconds	45 seconds	4 Sets
Concluding Section [15 min]	Slow walks around the gym while regulating deep inhales and exhales, followed by strenuous stretching exercises for the muscles of the back, shoulders, and arms working intensely during units.	Very low	15 minutes total	None	Quiet and continuous performance