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CONTRIBUTION PERCENTAGES OF SOME FUNCTIONAL VARIABLES AS AN INDICATOR OF MUSCLE DAMAGE AND THEIR RELATIONSHIP TO THE ACHIEVEMENT OF THE 100-METER FREESTYLE

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Abstract
The study aimed to identify functional variables indicative of muscle damage and to determine the contribution percentages of specific functional variables to performance in the 100-meter freestyle event, as well as to examine the relationships among these functional variables concerning the 100-meter freestyle run. The researcher utilized descriptive survey and correlational methodologies to correspond with the characteristics of the problem being examined. The study population consisted of eight individuals from the 100m junior category runners in Misan Governorate for the 2025 sports season. The study sample consisted of six runners, with two excluded due to injury, representing 75% of the research population. The researchers came to a number of important conclusions. After the juniors ran the 100-meter freestyle race, which was very hard on their bodies, their levels of functional variables went up a lot. This indicates that the traits of quick performance and explosive contractions lead to significant acute muscle damage. Moreover, there exist significant correlations between indicators of muscle damage and performance outcomes, suggesting that the increase of these variables following exertion is associated with a reduction in performance levels, thereby confirming the adverse effects of muscle strain on achievement. The main suggestions were to carefully grade the training loads for juniors to avoid muscle damage that could slow down their physical growth and future performance, and to make recovery a priority after effort, since damage levels go up a lot after speed competitions.
Keywords: Contribution, Percentages, Functional Variables, Muscle Damage, Achievement.

Introduction

The remarkable improvement in sports achievements in different countries and categories is an indication that there has been increased involvement of various sciences in the process of training with the goal of increasing efficiency and enhancing the technical aspect of the activities (Singh, 2023). The sport of athletics, especially the 100-meter free style running race, has gained a lot from this development in various countries. The sport involves high levels of energy and physical capacity (Agbayani, 2025). While undertaking this intense sporting activity, there are several physiological changes that occur in the body of the athlete. This is evident in an increase in important blood variables that act as key markers of these changes (Scheer et al., 2022). This is because these variables help in understanding the effects of such an explosive anaerobic activity on the body (Sandford, Laursen & Buchheit, 2021). Muscular injuries as a result of high levels of physical exertion constitute a major problem for athletes. Several critical markers and functional variables assist in assessing the extent of muscle injury and the response of runners to training (Tiller & Millet, 2025). The correlation between functional factors and performance in the 100-meter freestyle event represents a critical area for research (Hadi, 2025). This offers a chance to gain a comprehensive understanding of the factors influencing maximal speed and anaerobic capacity (Thron et al., 2024). It also elucidates the extent to which joints and muscles can execute rapid and repetitive contractions without substantial impairment from force (Rios, 2025).

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Therefore, it is crucial to examine the contribution ratios of these variables, as they serve as indicators of muscle damage. The significance of this research lies in its potential to establish the relationship between the contribution percentages of specific functional variables and performance, thereby allowing trainers to formulate more precise training programs. Establishing optimal recovery intervals, minimizing injuries, and enhancing the physical performance and accomplishments of runners.

Research Problem:

Sports training alone is inadequate for success without the scientific synergy that offers pertinent scientific metrics and values (Zhang, 2023). Studying and analyzing the aspects that contribute to performance success is an essential responsibility for both the coach and the player. Through the researchers' fieldwork and practical experience, specializing in speed training, as well as their review of scientific literature and studies. The researchers observed that the efficacy of the 100 meters is contingent upon peak performance. It necessitates a substantial capacity of functioning organs, particularly the muscles of the runner, due to the characteristics of the activity, which relies on the anaerobic phosphogenic energy system and the nature of the extreme anaerobic exertion. will result in a significant elevation of muscle injury biomarkers (enzymes). This will be evident in the muscles' response to physical exertion in generating the necessary force. The researcher observed deficiencies in studies examining the correlation between functional variables related to muscle damage and their influence on 100-meter performance. Furthermore, the insufficient understanding of the contribution percentages of these variables (enzymes) constitutes a gap that hampers trainers and researchers in identifying factors that detract from or enhance performance. The issue is from an insufficient amount of data to determine which of these variables serves as a more precise indicator in elucidating the disparities in achievement or judgment among runners. The issue lacks clarity and accuracy regarding the contributions to certain functional variables associated with muscle damage and its correlation with performance, hence constraining the development of training programs grounded in the physiological principles of achievement.

Research Objectives:

1. Identifying functional variables as an indicator of muscle damage.
2. Identifying the contribution percentages of some functional variables in the achievement of the 100-meter freestyle.
3. Identify the relationship between functional variables in the achievement of the 100-meter freestyle.

Imposing the Research:

1. There is a significant correlation between some functional variables as an indicator of muscle damage and achievement in the 100-meter freestyle event.

Research Areas

The Human Area: Athletes of the Misan Governorate Team, Junior Category, for the 2025 Sports Season.

Temporal Area: From (12/8/2025) to (1/10/2025).

Spatial Area: Misan Olympic Stadium Racecourse in Misan Governorate.

Methodology

Research Methodology

The researchers employed a descriptive survey method and correlation analysis to align with the nature of the problem under investigation. The descriptive method is characterized by its

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objective to gather data in order to test hypotheses or address inquiries pertaining to the present state of the research sample members (Jones, 2022).

The research population and its sample:

The researchers identified the track and field running community in Misan Governorate for the junior category of the 100m event for the 2025 sports season, comprising eight runners. Six runners were selected as a sample for the research, while two were excluded due to injury, representing 75% of the research population.

Homogeneity of the research sample:

Table 1: Shows the homogeneity between the sample members (arithmetic mean, standard deviation, coefficient of difference).

Variables	Unit of Measurement	M	SD	df
Weight	Kg	61.11	0.64	1.04
Length	Cm	1.59	0.01	0.62
Age	Year	16.65	0.88	5.28
Training Age	Year	2.05	0.07	3.41

Table (1) clearly indicates that the coefficient of difference for the research variables is below 30%.

Means, Devices and Aids Used in the Research:

Means of Information Collection:

- Arab and foreign scientific sources and references.
- Personal interviews for experts and specialists.
- -Tests and measurements.
- –World Wide Web.
- -Observation and experimentation.

Research Devices:

- Stadium, square, and legal field.
- HP Laptop Made in China No (1)
- Center fuge . (Japanese Made)
- Blood Analyzer – Spectrophotometer
- Electronic Height and Weight Measuring Device Made in China No (2).
- Stopwatch type (OMEGA) No (6).
- Kenko Handheld Calculator Made in China No (1).
- Tian Fu type whistle made in China No (2).
- Medical Syringe for Blood Draws Volume (5- CC) No 26.
- Sterilization Materials (Septidyne), Medical Cotton, Blood Protector (Cold Box) No (1), Medical Plastic Tape No (2).

Field Research Procedures:

Identifying the study variables and their tests:

- **Biochemical variables:**

- LDH.
- CK.
- Myoglobin.

Defining Research Measurements:

The functional variables related to muscle damage were discerned through an exhaustive review of prior research in exercise physiology and anaerobic exertion. This analysis concentrated on the common indicators employed

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to evaluate muscular responses to peak performance in sprinters. The researcher also spoke with a group of experts in sports physiology to make sure that these variables fit the sample's traits and work well. Furthermore, it was verified that the precision in selecting indicators sensitive to detecting muscle damage was guaranteed. All these measures significantly facilitated the adoption of functional variables distinguished by their capacity to quantify physiological changes, which are directly correlated with physical performance and achievement in the 100-meter sprint.

Description of Functional Variables:

A blood sample was collected prior to and following exertion. The research sample involved the collection of venous blood from the humerus region, as verified by Al-Masar Scientific. Additionally, personal interviews with several chemists confirmed that samples can be obtained from two sources: arterial blood and venous blood. However, all laboratory analyses are conducted using venous blood due to its superficial proximity to the skin and the significant risks associated with the extraction of arterial blood from deeper tissues. Blood samples are placed in specialized preservation tubes containing the anticoagulant EDTA. Numbered in accordance with the order of players, such that the number denotes the player's name, subsequently separated in the extraction centrifuge. Variables examined from each tube, with assistance from a trained chemist, were thereafter sent to the laboratory for the determination of functional blood variables.

Test Completion of a 100-Meter Run from a Seated Starting Position (IAAF, 2019).

1. **Purpose of the test:** Measurement of the Achievement of Running (100) Meters.
2. **Tools used**:
   a. A running area with a distance of 100 meters according to the legal requirements.
   b. B. Three hours of time (for the two clocks) or a device (photofinch)
   c. C. Starting gun (firing sound).
3. **Performance Method**: The test commences promptly following the warm-up procedure, with instructions provided to the laboratory at the starting line. The tester assumes a seated start position, after which the launcher issues the start signal. At this moment, the timers activate the time clocks, which are halted upon the laboratory's arrival at the finish line.
4. **Measurement method:** The time is recorded to the closest 0.01 seconds over three hours, utilizing the photofinch gadget, with electric timing employed.

Field Research Procedures:

Exploratory Experiment:

The exploratory experiment is an essential procedure that researchers must conduct, as it trains them to identify the challenges and advantages encountered during testing, facilitating the avoidance of these issues in subsequent endeavors (Skinner et al., 2024). The researchers executed an exploratory experiment on Tuesday, December 8, 2025, at 4:00 PM, using two runners from the same research sample at the Misan Olympic Stadium, aimed at measuring functional characteristics and conducting an achievement test for identification purposes:

1. The ability of the sample members to carry out the test and the way they interact with it.
2. Learn when to take the test and how long it takes.
3. Identify enough time to take the test.
4. Identify difficulties, obstacles, and errors that will arise during the implementation of the test.
5. Identify the devices and tools needed to carry out the experiment and test.
6. Validity of the place where the main experiment will take place.
7. Define the duties of the assistant team.
8. Identify test performance time.

Main Experience:

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The researchers, along with the assistant work team, conducted the achievement test and measured the functional variables post-performance on the research sample on Sunday, August 17, 2025, at 4 PM, at the Misan Olympic Stadium after completing all necessary preparations.

Statistical Methods:

- Arithmetic mean.
- Standard deviation.
- Broker.
- Torsion coefficient.
- Percentage.
- Simple Pearson Link.
- Percentage of Contribution.
- Standard Error.

Results

Present, analyze and discuss the results:

Subsequent to the researchers' measurements of the research variables, the data underwent statistical analysis. The ensuing section presents the results in tabular form, followed by a discussion supported by scientific literature.

Presentation of the results of the descriptive statistical parameters for some functional variables and achievement:

Table 1: Descriptive statistical parameters of some functional variables and achievement.

Variables	Unit of Measurement	M	SD	Broker	Torsion coefficient	Standard Error
Achievement of 100m Run	Second	13.44	0.382	13.45	0.013	0.156
Ldh	L/U	243.33	26.77	242.50	0.148	10.92
Ck	L/U	198.33	26.77	197.50	0.148	10.92
Myoglobin	ML /N	63.00	12.32	62.50	0.187	5.03

Presentation and discussion of the results of the correlation and contribution ratios between some functional variables and the achievement of the 100 meter run:

Table 2: Shows the results of the arithmetic media, standard deviations, calculated value (R), value (F), contribution percentage, and the level of significance between some functional variables and achievement

Variables	Unit of Measurement	M	SD	R	F	Percentage of Contribution	Sig
Achievement of 100m Run	Second	13.441	0.382	-----	-----	-----	-----
Ldh	L/U	243.333	26.77	0.921	1986.80	0.920	0.000
Ck	L/U	198.333	26.77	0.921	1986.80	0.920	0.000
Myoglobin	ML /N	63.000	12.32	0.918	1245.71	0.917	0.000

*The level of the function when the value of (R) is below the level of significance (0.05) at the degree of freedom (5).

Analysis of the Results Discussion:

Table (2) of functional variables indicated that the contribution % of the variable (lactic dehydrogenase) to the level of performance was considerable, reaching (0.920), with a correlation value of (0.921). The

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researchers ascribe these percentages to the positive correlation between the LDH variable and the level of achievement, while the contribution percentage of the creatine phosphate kinase variable to the level of achievement was notably 0.920, with a correlation coefficient of 0.921. The researchers ascribe these percentages to the positive correlation between the (CK) variable and the level of achievement, whereas the contribution percentage of the (myoglobin) variable to the level of achievement was notably (0.917) with a correlation coefficient of (0.918). The researcher ascribes these percentages to the positive correlation between myoglobin levels and achievement, as the current study's results indicate a significant correlation between muscle damage indices (LDH, CK, Myoglobin) and performance in the 100-meter freestyle event, with regression coefficients demonstrating that these variables account for a substantial proportion of the variance in achievement. The researchers ascribe this strong correlation to the physiological characteristics of the 100-meter race, an intense anaerobic activity that depends on the muscles' capacity to generate substantial strength in a brief duration, resulting in considerable stress on muscle tissue and an increase in blood-damaging substances. The researchers suggest that the enzyme lactate dehydrogenase plays a major role in performance because extreme stress, especially during anaerobic training, affects its activity. It is particularly important in the case of the 100-meter event, as this enzyme occurs in the heart, skeletal muscle, kidney, liver, brain, and erythrocytes. Various research findings indicate that this enzyme participates in the process of lactic acid degradation; thus, the higher the enzyme activity, the higher the rate of degradation of lactic acid. This enzyme is present in heart muscle tissue, where it catalyzes the conversion of lactic acid into pyruvic acid. The LDH enzyme is one of the muscle biomarkers that help maintain a balance between aerobic and anaerobic metabolism through easy conversion from pyruvic acid to lactate and vice versa (MacLaren & Morton, 2024).High blood LDH levels often mean that muscle tissue is damaged or that the body is relying more on anaerobic pathways during intense activity (Lee et al., 2023). Consequently, evaluating it before and after performance yields insights into the magnitude of muscular adaptations resulting from training. Wernbom et al. (2021) contend that increased concentrations of LDH in the bloodstream following exertion generally indicate damage to muscle cell membranes, thereby allowing its entry into circulation. Kenney, Wilmore, and Costill (2022) contend that reliance on an augmented anaerobic pathway leads to oxygen deficiency during physical exertion, accompanied by increased mechanical and analog stress on muscle fibers. This type of stimulation causes small amounts of muscle damage, which leads to the release of LDH into the blood. The researchers say that the enzyme (LDH) is a sign of muscle damage, and that higher levels of it are linked to more signs of damage. As a result, lower levels of this enzyme are a good way to tell how well an athlete can adapt. So, regular training makes blood circulation and the enzymes that get rid of lactate from muscles work better. Creatine kinase (CK) is an important sign of muscle damage because its levels go up when muscle fibers get small tears from hard work. The results showed that CK is a very important factor in predicting how well someone will do in the 100 meters. This is consistent with the characteristics of the race, which relies on explosive muscle contractions. There is an enzyme (CK) present in high amounts in the muscle fibers, and its increased presence in the blood is seen as a sign of muscle injury caused by intense stress. High-intensity exercise causes a lot of stress and puts mechanical strain on tissues, which is why the CK enzyme levels are expected to go up (Crea, 2024; Wahl, Bloch, and Proschinger, 2022). Creatine kinase is an important biomarker for muscle damage caused by physical stress. High levels of this enzyme in the blood show how much muscle fiber damage has occurred or how much the cell membrane has become more permeable because of stretching or overload during exercise. So, looking at changes in enzyme levels before and after exercise is a direct way to see how the muscles respond to physical activity, especially in high-intensity anaerobic activities like the 400-meter race. Researchers suggest that the increase in CK enzyme levels is due to metabolic stress and higher blood acidity. This is because intense anaerobic exercise causes lactic acid to build

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up, which changes the muscle's internal environment and makes it more permeable. The release of the CK enzyme into the bloodstream, as noted by Hostrup, Cairns, and Bangsbo (2021), indicates that ionic changes in the cell play a big role in the rise after exercise. High levels of myoglobin are one of the first signs that muscle cells are hurt because it quickly leaves the muscle after a lot of work (Schwiete et al., 2025). The study's findings demonstrated a significant correlation between myoglobin levels and performance, suggesting that runners with increased muscle injury experience reduced performance. Training and hard work can change how this protein works. Myoglobin is an important muscle protein that can be hurt and helps move oxygen through muscle fibers. It helps move things from membranes to mitochondria when muscles contract, especially when they are under stress or have been hurt, which causes things to leak into the bloodstream because the cell membrane is damaged or more permeable. So, checking its level after exercise is a good way to measure how much the muscles respond to training, whether it's short-term or long-term. Researchers claim that training at a high intensity and doing the same thing over and over again raises myoglobin levels. As a result, muscle injury, especially at high intensity, often leads to a continuous leakage of muscle proteins, occurring both after exercise and during rest periods, as shown by Leite et al. (2023). Athletes who undergo excessive training loads without sufficient medical intervention will demonstrate consistently elevated levels of myoglobin, indicative of muscle injury.

Conclusions:

1. Junior LDH, CK, and myoglobin levels showed a significant rise after intense physical exertion in the 100-meter freestyle, suggesting that the high speed of performance and strong contractions lead to significant acute muscle injury.
2. The strong links between muscle damage markers and performance outcomes suggest that an increase in these variables after exercise is linked to a drop in performance levels. This shows that muscle fatigue has a negative effect on achievement.
3. The effect of factors on predicting achievement was significant.
4. The rapid rise in signs of muscle damage after exercise shows that the muscle tissue of fast fibers can handle a lot of voltage, which is in line with the anaerobic pathway used in sprint events.
5. Measuring the variables after exercise showed that the participants' performances were different, which suggests that the post-exertion period is a good way to measure muscle strain.

Recommendations:

1. The imperative of gradually modifying training loads with careful consideration when exercising juniors, to reduce muscular damage that may affect their physical development and future performance.
2. Emphasizing the significance of recovery after exertion for children, as their injury rates markedly escalate subsequent to speed events.
3. Utilizing these functional indicators as routine evaluative tools in junior training programs offers accurate insights into their endurance and muscular response capabilities.
4. Proposing the implementation of follow-up studies to evaluate damage indicators before and after the intervention, in order to estimate hospitalization rates among youngsters and analyze their progression over time.

References

1. Agbayani, J. V. (2025). A comparative analysis of 100-meter sprint among Gen-Z regional non-athletics and non-athletes in Ilocos Norte.
2. Crea, E. (2024). Effects of repeated High-Intensity Interval Training interventions on oxidative metabolism adaptations in human skeletal muscle.

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https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

3. Hadi, I. M. A. (2025). The effectiveness of specialized exercises in enhancing certain physiological variables and achieving success in the 100 m freestyle. *European Journal of Sports Science Technology*, *15*(56), 11-22.
4. Hostrup, M., Cairns, S. P., & Bangsbo, J. (2021). Muscle ionic shifts during exercise: implications for fatigue and exercise performance. *Comprehensive Physiology*, *11*(3), 1895-1959.
5. International Athletics Federation (IAAF). (2019). Competition Rules. Cairo: Development Center for Athletics.
6. Jones, I. (2022). *Research methods for sports studies*. Routledge.
7. Kenney, W. L., Wilmore, J. H., & Costill, D. L. (2022). *Physiology of sport and exercise*. Human kinetics.
8. Lee, S., Choi, Y., Jeong, E., Park, J., Kim, J., Tanaka, M., & Choi, J. (2023). Physiological significance of elevated levels of lactate by exercise training in the brain and body. *Journal of bioscience and bioengineering*, *135*(3), 167-175.
9. Leite, C. D., Zovico, P. V., Rica, R. L., Barros, B. M., Machado, A. F., Evangelista, A. L., ... & Bocalini, D. S. (2023). Exercise-induced muscle damage after a high-intensity interval exercise session: systematic review. *International journal of environmental research and public health*, *20*(22), 7082.
10. MacLaren, D., & Morton, J. (2024). *Biochemistry for sport and exercise metabolism*. John Wiley & Sons.
11. Rios, I. J. C. (2025). Introduction to Muscle Strength and Force in Sports Science. In *Functional Electromechanical Dynamometry* (pp. 3-22). Routledge.
12. Sandford, G. N., Laursen, P. B., & Buchheit, M. (2021). Anaerobic speed/power reserve and sport performance: scientific basis, current applications and future directions. *Sports medicine*, *51*(10), 2017-2028.
13. Scheer, V., Tiller, N. B., Doutreleau, S., Khodaee, M., Knechtle, B., Pasternak, A., & Rojas-Valverde, D. (2022). Potential long-term health problems associated with ultra-endurance running: a narrative review. *Sports Medicine*, *52*(4), 725-740.
14. Schwiete, C., Roth, C., Mester, J., Broich, H., & Behringer, M. (2025). Overlaps of skeletal muscle fatigue and skeletal muscle damage: the muscle injury continuum. *Sports Medicine-Open*, *11*(1), 73.
15. Singh, H. (2023). *Science of sports training*. Friends Publications (India).
16. Skinner, J., Smith, A. C., Read, D., Burch, L. M., & Mueller, J. (2024). *Research methods for sport management*. Routledge.
17. Thron, M., Düking, P., Ruf, L., Härtel, S., Woll, A., & Altmann, S. (2024). Assessing anaerobic speed reserve: A systematic review on the validity and reliability of methods to determine maximal aerobic speed and maximal sprinting speed in running-based sports. *Plos one*, *19*(1), e0296866.
18. Tiller, N. B., & Millet, G. Y. (2025). Decoding ultramarathon: muscle damage as the main impediment to performance. *Sports Medicine*, *55*(3), 535-543.
19. Wahl, P., Bloch, W., & Proschinger, S. (2022). The molecular signature of high-intensity training in the human body. *International journal of sports medicine*, *43*(03), 195-205.
20. Wernbom, M., Paulsen, G., Bjørnsen, T., Cumming, K., & Raastad, T. (2021). Risk of muscle damage with blood flow–restricted exercise should not be overlooked. *Clinical Journal of Sport Medicine*, *31*(3), 223-224.

Proximus Journal of Sports Science and Physical Education
Volume 3, Issue 04, April, 2026
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

21. Zhang, X. (2023). The role of integration of sports and medicine, training processes, and physical fitness in athlete performance and athlete sports success. *Revista de Psicología del Deporte (Journal of Sport Psychology)*, *32*(3), 142-153.