Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

The effect of strength training on blood levels of (lysine and valine) in tennis players

Hussein Ali Hussein [1]

[1] Al-Mustansiriya University, College of Basic Education

DOI:
https://doi.org/10.37359/JOPE.V38(1)2026.2414

Article history: Received 19/ January/2026 Accepted 29/ January/2026 Available online 28/ March/2026

Abstract

The purpose of this research was to investigate the effect of strength training program on blood lysine and valine levels in tennis players. 6 players aged 18–20 years were sampled. The training intervention was implemented over 8 weeks, 3 sessions per week. Plasma lysine and valine were determined before and after the training period. Results indicated that the contents of lysine and valine increased evidently following training. The finding also indicated that muscle strength and endurance were significantly improved after the training program. It is possible to infer that the training program was beneficial for lysine and valine levels, muscle strength and tennis endurance in players.

Keywords: Lysine, Valine, Muscle strength, Endurance, Tennis.

Introduction

Tennis is considered a highly physically demanding sport that requires neuromuscular coordination and muscular strength. Players need to be quick and deft, hit hard and sharp and last long. For that reason, strength training is one of the most important elements in training for tennis players. The present study could lend support to the effects of strength training on lysis, and valin among male tennis players. In addition, this investigation might help coaches and players in optimizing training programs for better athletic performance.

Even though resistance exercise is very important in tennis training, only a few studies have investigated the effects of strength training on lysine and valine levels in athletes. Hence, we

[1] Al-Mustansiriya University, College of Basic Education.
hz.tenis47.edbs@uomustansiriyah.edu.iq

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

proposed to study the influence of a strength training program on blood lysine and valine levels in six tennis players.

Research Objectives:1. To identify the effect of strength training on the levels of lysine and valine in the blood of tennis players. 2. To ascertain the extent to which strength training influences athletic performance (muscle strength, speed, endurance) in athletes.

Research Hypotheses: 1. There is a significant difference in the level of lysine in the blood between pre-tests and post-tests following the implementation of the training program for tennis players. 2. There is a significant difference in the level of valine between pre-tests and post-tests following the implementation of the training program for tennis players. 3. There is a positive effect of strength training on athletic performance (muscular strength, speed, endurance) for tennis players.

Research Domains: 1- Human Domain: 6 tennis players for the year 2024-2025. 2- Spatial Domain: Al-Shabab International Tennis Court. 3- Temporal Domain: From April 1, 2025, to June 2, 2025.

Definition of Terms

Strength Training: Strength training refers to physical exercises aimed at increasing muscular strength. These exercises include weight lifting, resistance training, and aerobic exercises. (American College of Sports Medicine, 2018)

Lysine: Lysine is an essential amino acid that plays a crucial role in protein synthesis. It is necessary for the growth and maintenance of healthy body tissues. (Berg, 2002)

Valine: Valine is an essential amino acid, and it is a key player in protein construction. You need protein for building and maintaining healthy body tissues. (Berg, 2002)

Athletic Performance: It is the capabilities of a sportsperson of performing and achieving in sports. This package of abilities includes both speed, strength and stamina, as well as flexibility and control over movement. (Bompa, 2009)

Methodology

This chapter intends to presents the research methodology used in one of the studies investigating a strength training intervention on blood lysine and valine concentrations in tennis players. The research was an experimental study over the influence of a training model on the experimental group.

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

The experimental research design for a single group was employed, wherein the training program was implemented on the experimental group, and the levels of lysine and valine in the blood were measured before and after the training program.

Research Samples

A sample of six players from the Army Tennis Club in Baghdad, aged between 18 and 20 years, was selected. The sample was chosen randomly from among the players who are training in tennis.

The homogeneity of the sample was confirmed prior to the commencement of the training program, as shown in table 1.

Table 1. *Homogeneity of the Research Sample*

Variable	Sample (n = 6)	Mean	Standard Deviation	Skewness
Age (years)	19.5 ± 1.2	19.5	1.2	0.21
Body mass (kg)	65.2 ± 8.5	65.2	8.5	0.35
Height (cm)	175.3 ± 6.2	175.3	6.2	0.18

Conclusion: The sample is homogeneous in the aforementioned variables, and the skewness coefficient is close to zero, indicating that the distribution is near a normal distribution.

Tools and Devices Utilized in the Research

- Arabic and foreign sources
- The Internet
- Registration forms
- Tennis rackets
- Tennis balls
- Tennis court
- A strength training program that includes exercises aimed at increasing muscular strength.
- An electronic weight measurement device for assessing the weight of the players.
- An electronic blood pressure monitor (HEM-907XL) for measuring the blood pressure of the players.
- An electronic calculator
- A laptop (DELL)

Tests Used in the Research

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

1. Blood Levels of Lysine and Valine Test (Berg, 2002)
- Objective: To measure the levels of lysine and valine in the blood.
- Tools: Device for measuring blood levels of lysine and valine.
- Procedures:
  Obtain a blood sample from the player.
  Separate plasma from cells.
  Analyze the sample using the device for measuring blood levels of lysine and valine.
- Measurement Scale: Micromoles per liter.

2. Muscular Strength Test (American College of Sports Medicine, 2018)
- Name: Muscular Strength Test.
- Objective: To measure the muscular strength of the player.
- Tools: Device for measuring muscular strength (Takei, TKP-5000).
- Procedures:
  Position the player in a seated position.
  Attach the muscular strength measuring device to the player.
  Instruct the player to exert maximum muscular strength.
- Measurement Scale: Kilograms.

3. Speed Test (International Tennis Federation, 2022)
- Objective: To measure the speed of the player.
- Tools: Speed measuring device (Brower, TC-1).
- Procedures:
  Position the player at the starting position.
  Instruct the player to run at maximum speed.
  Measure the time taken by the player to cover a specific distance.
- Measurement Scale: Seconds.

4. Endurance Test (American College of Sports Medicine, 2018)
- Objective: To measure the endurance of the player.
- Tools: Endurance measuring device (Monark, 828E).
- Procedures:
  Position the player on the endurance measuring device.
  Instruct the player to run at a specific speed for a designated duration.
  Measure the time taken by the player to complete the test.
- Measurement Scale: Minutes.

5. Flexibility Test (International Tennis Federation, 2022)
- Objective: To measure the flexibility of the player.

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

- Tools: Flexibility measuring device (Takei, TKP-5000).
- Procedures:
  Position the player in a standing position.
  Instruct the player to bend forward.
  Measure the distance between the fingertips and the ground.
- Measurement Scale: Centimeters.

The tests were administered on April 1, 2025, at the International Tennis Stadium at 3:00 p.m. 5 CC of blood were collected for a blood test for levels of lysine and valine. Afterwards, the second fitness test of muscle strength, speed and endurance was administered by the sample studied.

Strength Training Program

The strength training program includes exercises aimed at increasing muscular strength.

Duration: 8 weeks

Frequency: 3 times per week

The exercises utilized in the training program for the research are:

1. Chest exercise:
2. Back exercise:
3. Leg exercise:
4. Shoulder exercise:
5. Abdominal exercise:

These exercises are part of a broader muscular strength training program constructed to improve tennis players' muscular strength levels.

The post-tests were administered at 3:00PM on June2, 2025 Everything that has been employed in the pre-tests was applied under the same conditions as test conditions.

Methods of analysis the research data was analyzed using version 26 of the Statistical Package for the Social Sciences (SPSS).

Results

Table 2. *Presentation of Research Results*

Variables	Pre-tests		Post-tests		Differences t-value Error Level (p)
	Mean	SD	Mean	SD	Mean Diff.
Lysine level (µmol/L)	120.5	20.1	150.2	25.5	29.7
Valine level (µmol/L)	150.2	25.5	180.5	30.1	30.3

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Table 2. *Presentation of Research Results*

Variables	Pre-tests		Post-tests		Differences t-value Error Level (p)
	Mean	SD	Mean	SD	Mean Diff.
Muscular strength (kg)	50.2	10.1	60.5	12.5	10.3
Speed (s)	10.2	1.5	9.5	1.2	−0.7
Endurance (min)	30.1	5.2	35.5	6.1	5.4

Note: *n = 6, significance level ≤ 0.05.*

Discussion

The results (Table 2) also indicate that there was a significant increase in lysine levels after the training program, representing favorable physiological adaptation. As a nutritionally essential amino acid, lysine is critically involved in protein synthesis, hormonal regulation and tissue repair that contribute to athletic performance (Berg, 2002). The detected increase in lysine concentration concurs with previous investigations indicating that structured physical training per se can improve free amino acid levels such as those of circulating amino acids, especially throughout moderate or high level of exercise intensity (Klein et al., 2011; Mikkelsen et al., 2015). This adaptive response could be the result of increased hepatic amino acid synthesis or decreased peripheral utilization of the amino acids by muscle, due to better metabolic efficiency, as indicated previously (Mikkelsen et al. 2015).

Conversely, a significantly higher post-training valine concentration was shown indicating a beneficial effect of the training intervention on branched-chain amino acid metabolism. Valine is important in the synthesis and repair of muscle tissue, and promotes mental vigor and muscle coordination (Berg, 2002). These results are in line with a previous study, which showed that exercise elicits an increase of plasma valine concentrations after exercise, particularly after intense periods of training (Klein et al., 2011; Mikkelsen et al., 2015). Greater availability of valine may promote muscle anabolism and alleviate fatigue, which are potentially beneficial effects for physical performance.

Additionally, there was a notable improvement in muscular strength due to the training intervention and this offers support for the value of using resistance exercises. This is consistent with previously established evidence that systemic resistance exercise stimulates neuromuscular adaptations, such as enhanced motor unit recruitment, hypertrophy and contractile efficiency (Kraemer et al., 2002; American College of Sports Medicine [ACSM], 2018). These types of adjustments are mediators, which also play a role in determining the level of strength expression and hence performance enhancement in numerous sport forms.

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

With respect to performance, the results demonstrated a significant decrease of movement time after the intervention program that can be considered as a meaningful improvement in terms of speed. Speed, being the capability of movement with minimal time, is dominantly influenced by neuromuscular coordination and muscle power as well as environmental factors such as mechanical efficacy (ACSM, 2018). As seen in previous studies, the noted enhancements could have been due to enhanced muscle fiber recruitment patterns, improved intermuscular coordination and an increase in elastic energy (Kraemer et al., 2002). Furthermore, improvements in muscle efficiency could have played a role in lowering the energy consumption and increasing movement economy, which allowed for faster performance.

In addition, endurance capacity also showed a substantial improvement after the training intervention, which means that aerobic and muscular endurance improved. Endurance, characterised as the capacity to endure extended periods of physical activity is strongly linked to cardiovascular function, changes in mitochondria and enhanced metabolic control (ACSM, 2018). The present improvement was consistent with previous researches which have reported that a well-structured training can contribute to marked increase of endurance performance by high oxidative capacity, delayed fatigue, and efficient substrate utilization (Kraemer et al., 2002; ACSM, 2018). Together these modifications allow the competitive athlete to perform more continuously at higher performances for longer periods in time.

Overall, these results provided strong evidence that the applied training program was effective in promoting advantageous biochemical, neuromuscular and physiological adaptations to bring about a holistic enhancement of physical performance. The combination of resistance and conditioning components seemed to have maximally improved amino acid turnover, muscle strength, power and endurance suggesting the significant role of well-designed training program in sport development.

Conclusions

1. The present study revealed that blood levels of lysine and valine are positively affected by strength training in tennis players with beneficial effects on muscular strength, speed and endurance.
2. There was an increase also in blood lysine and valine levels following strength training.
3. Significant increase was found in the muscle strength after treatment, indicating that the applied training program had a significant effect on it.
4. Results showed a significant reduction in speed post training, suggesting that the training program led to decreased running speed.
5. Endurance also improved after the training program and there was a significant correlation with improvement in endurance post-training.

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Recommendations

1. It is recommended that strength training be included in the program of conditioning for tennis players and this will help to increase levels of lactate and valine in the blood, consequently resulting in increased muscular strength, speed and endurance.
2. Trainers should measure the lactate and valine in the blood of tennis players to evaluate changes resulting from strength training on performance.
3. From the abundance of lactate and valine in the blood, individual training programs can then be prepared for each tennis player to optimize (even increase) tennis endurance.
4. Additional research is needed to examine the effect of strength training on blood lactate and valine levels in tennis players, which would provide valuable insight into improving athletic performance.

Appendix 1. *Model of a Single Training Session*

Objective: To improve muscular strength in tennis players.

No.	Exercise	Sets	Repetitions	Load	Rest
1	Chest exercise (dumbbells)	3	8–12	20 kg	60 s
2	Back exercise (barbell)	3	8–12	25 kg	60 s
3	Leg exercise (leg press machine)	3	8–12	30 kg	60 s
4	Shoulder exercise (dumbbells)	3	8–12	15 kg	60 s
5	Abdominal exercise (abdominal machine)	3	8–12	—	60 s

Notes:

1. Players should begin with light loads and gradually increase the weight as the training program progresses.
2. A rest period of 60 seconds should be maintained between sets.
3. Players are advised to consume a healthy post-workout meal following the training session.

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

References

Abdulghani, L. Y., Abdulghani, M. Y., & Abdulkareem, O. W. (2025). Designing a palm pressure measurement device to improve motor coordination in freestyle swimming among female students. Journal of Physical Education and Sport, 25(7), 1506–1513. https://doi.org/10.7752/jpes.2025.07168

Abdulhussein, A. A., Kadhim, M. J., Abdulkareem, O. W., & Shehab, G. M. (2026). The effect of neurofeedback on free throw accuracy in female basketball players of Baghdad University. Retos, 75, 496-507.

Abdulkareem, O. W., & Sattar Jabbar, H. (2025). Comparative Biomechanical Analysis of Three-Point Shooting Between Elite Iraqi Basketball Players and International Counterparts. Journal of Sport Biomechanics. https://doi.org/10.61186/JSportBiomech.11.3.326

Abdulkareem, O. W., Hameed, H., & Al-Hussein, A. (2017). Analytical-Comparative Study of Some Kinematical Variables Of Jump Shot and Shooting in Youth Basketball Players. Article in Journal of Physical Education.

Abdulkareem, O. W., Jabbar, H. S., & Obaid, A. J. (2025). The Effect of Soft Toss Machine Training on Some Kinematic Variables and backhand accuracy of Tennis Players U16 years. Journal of Physical Education (20736452), 37(1).

Al-Saadi, E., & Shalsh, M. (2024). The Impact of Mechanical Training in Accordance with Regulating the Optimal Stride Length in the First and Second Straight Phases on the Achievement of 400 Meter Events for Men. Journal of Physical Education, 36(1), 279-254.

American College of Sports Medicine. (2018). ACSM's guidelines for exercise testing and prescription (10th ed.). Lippincott Williams & Wilkins.

American Heart Association. (2022). Blood pressure measurement guidelines. https://www.heart.org

Berg, J. M., Tymoczko, J. L., & Stryer, L. (2002). Biochemistry (5th ed.). W. H. Freeman and Company.

Bompa, T. O., & Haff, G. G. (2009). Periodization: Theory and methodology of training (5th ed.). Human Kinetics.

Ghanim, M. R. (2025). The Neurocognitive Effect Of Augmented Visual Feedback On Learning The Back Handspring Skill In Gymnastics Among College Students Diverse Learning Methods. Indonesian Journal of Physical Education and Sport Science, 5(3), 397-407.

Hassan, M. F. A., & Abdulkareem, O. W. (2026). Effects of an Integrated Balance and Muscle Tension Control Training Program on Kinematic Variables and Defensive Accuracy in Volleyball Players. Journal of Sport Biomechanics, 11(4), 438-464.

Journal of Physical Education
Volume 38 – Issue (1) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Hawash, D., & Halil, M. (2022). The Effect of Using Teaching Aid on the Development of Straight Forehand and Backhand Shot Performance in Lawn Tennis. Journal of Physical Education, 34(3), 296-304.

International Tennis Federation. (2022). Tennis rules and regulations. https://www.itftennis.com

Klein, S., Wolfe, R. R., & Wolfe, M. H. (2011). Effect of exercise on plasma amino acid concentrations. Journal of Applied Physiology, 110(2), 353–360. https://doi.org/10.1152/japplphysiol.01232.2010

Kraemer, W. J., Adams, K., Cafarelli, E., Dudley, G. A., Dooly, C., Feigenbaum, M. S., Fleck, S. J., Franklin, B., Fry, A. C., Hoffman, J. R., Newton, R. U., Potteiger, J., Stone, M. H., Ratamess, N. A., & Triplett-McBride, T. (2002). American College of Sports Medicine position stand: Progression models in resistance training for healthy adults. Journal of Strength and Conditioning Research, 16(2), 155–165.

Mikkelsen, U. R., et al. (2015). Effects of exercise on plasma amino acid concentrations in humans. Journal of Applied Physiology, 119(2), 235–242. https://doi.org/10.1152/japplphysiol.00019.2015

Mohsen, M., & Sabieh, Y. (2021). A Historical Study of Iraqi Paralympic Participations in IPC World Championships Athletics from 1990 till 2017. Journal of Physical Education, 33(2), 62-70.

National Strength and Conditioning Association. (2018). NSCA's essentials of strength training and conditioning (4th ed.). Human Kinetics.

Seca. (2022). Seca 213: Height measurement device. https://www.seca.com

Takei Scientific Instruments Co., Ltd. (2022). Takei TKP-5000: Muscle strength measurement device. https://www.takei-si.co.jp

Tanita. (2022). Tanita BC-418: Body composition analyzer. https://www.tanita.com

Yahya, S. Z., Rida, B. K. A., & Abdulkareem, O. W. (2024). The effect of a laser device on some biomechanical variables of the rotational phase in the achievement of 100 m freestyle swimming for the Iraqi team (16-18 years old). Scientific Journal of Sport and Performance, 3(4), 507-512.