# EFFECTS OF SPEED, AGILITY, AND QUICKNESS TRAINING ON BIOCHEMICAL PARAMETERS OF UNDER-19 NATIONAL-LEVEL ELITE SOCCER PLAYERS: A TWELVE-WEEK INTERVENTION STUDY

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**Abstract**

**Purpose:** This study investigated the effects of Speed, Agility, and Quickness (SAQ) training on the biochemical parameters of under-19 (U-19) national-level elite soccer players.

**Materials and Methods:** Fifteen elite soccer players with an average age of 16.87±1.13 years, an average weight of 61.87±5.94 kg, an average height of 172.82 ± 5.18cm, an average training age of 5.0±1.0 years, and intermediate participation in the national level competition for 4.0±1.0 years participated in the study. After baseline data collection, the participants underwent a twelve-week SAQ training program consisting of one hour of training per day for four days a week. Biochemical parameters, including red blood cells (RBC), Creatine, Hemoglobin, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very-low-density lipoprotein (VLDL), were measured before and after the training program. The significance level was set at $P<0.05$.

**Results:** The results showed a significant improvement in some segments of power performance in selected elite soccer players during the twelve weeks of SAQ training. Specifically, there was a substantial increase in RBC, Creatine, Hemoglobin, and HDL and a significant decrease in LDL and VLDL**.**

**Conclusion:** The study findings revealed that prolonged SAQ training and physical activities impact the biochemical parameters of elite soccer players. Proper planning and implementation of SAQ training can enhance the performance of soccer players and help maintain the potency of performance.

**Keywords** Soccer, SAQ, Training, Biochemical parameter, Performance.

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**Author Contribution Statement**

Study Design, SM.F., M.M. and P.D.; Data Collection, SM.F.; Statistical Analysis, SM.F. and WS. S; Data Interpretation, SM. F, WS.S. and S.R..; Manuscript Preparation, SM.F., WS. S; Literature Search, SM.F. and S. R.

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## 1. Introduction

Soccer is one of the most popular games all over the world. It consists of various forms of skill and techniques. To get peak performance, one needs to go through multiple forms of training indices. The training-induced changes in different physiological and biochemical parameters attributed to appropriate load dynamics. It is assumed that one of the hallmarks of good training status in most competitive sports is an increment in muscle mass with a concomitant reduction in fat mass (Wittich A, 2001). Speed, agility, and quickness (SAQ) training have to be a prevalent way to train athletes. Whether they are school children on a football field or professionals in a training camp, they can all benefit from the speed, agility, and quickness training. This process has been around for several years, but it is only used by some athletes primarily due to a lack of education regarding the drills. Speed, agility, and quickness training may be used to increase speed or strength or the ability to exert maximal force during high-speed movements. Some benefits of speed, agility, and quickness training include increases in muscular power in all multiplanar directions; brain signal efficiency; kinesthetic or body spatial awareness; motor skills; and reaction time (Bompa TO, 2000). In soccer, many physical contacts occur, and many movements and skills are involved. A high level of physical demand is required, which involves kicking, short sprinting, throwing, catching, trapping, etc. (Hoff, J. 2005). Soccer players have to cover a big area in the ground during attacks and defenses; the game demands aerobic and anaerobic fitness (Reilly, T. 2005). A high number of accelerations and decelerations associated with many changes in the direction of play create an additional load on the muscles' involvement. So, just those players suited to cope with these demands and reach elite levels (Nielsen, 2007). The intermittent high-intensity pattern of activity during matches requires a high function of both aerobic and anaerobic energy delivery pathways (Laursen, P. B. 2010). A high number of accelerations and decelerations associated with many changes in the direction of play create an additional load on the muscles' involvement. So, just those players suited to cope with these demands reach elite levels (Silva, 2015). There are countless training strategies to improve football skills, like speed, agility, and quickness (Brown, 2014, Dawes, 2008, Halberg, 2001). The biochemical and physiological parameters apprehend the soccer player's intensity pattern, which has played a vital role in the evaluation and assessment of performance, metabolism, and cardiovascular status of the training program (Calahorro, F, 2011). This study aimed to assess the changing way of biochemical parameters after 12 weeks of SAQ training in selected 15 males under 19 national-level elite soccer players of Poloi Academy from Manipur, India.

## 2. Methodology

***2.1 Research question and hypothesis:*** The research question was to determine the effect of twelve weeks of speed, agility, and quickness training on the biochemical parameters of under-19 elite soccer players. The hypothesis was that the training led to significant changes in the biochemical parameters of the players.

***2.2 Study design:*** The study has a pre-post intervention design, with biochemical parameters measured at baseline and after twelve weeks of training. The study also involves a meta-analysis. The results of this study are combined with similar studies to determine the overall effect of speed, agility, and quickness training on biochemical parameters in elite soccer players.

***2.3 Participants:*** The present study was conducted on fifteen elite soccer players at Poloi Academy of Manipur, India, U-19 national players (average age 16.87±1.13 years; average weight 61.87±5.94 kg; height 172.82 ± 5.18cm) played for the last 3-4 years regularly in competitions and participated in National Level Competition. Players were well informed and given a proper explanation about the study procedure, and informed consent was collected from Academy, individuals, and Parents. The study protocol was retained for every participant. All the selected players for the study underwent the SAQ training for 12 weeks after the baseline data collection (Sahir, M. 2019, McDermott, S. 2016, McDermott, S. 2016). The study was conducted in June-October 2022. The Institutional Human Ethical Committee approved the protocol adopted for the study (Ref: TU/IHEC/3/1/22) invariant with the necessity for human experimentation per the declaration of Helsinki. Biochemical variables, namely red blood Cell (RBC), Creatine, Hemoglobin, High-density lipoprotein (HDL), Low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL), were investigated in this study. The SAQ training schedule program is represented in Fig 1.

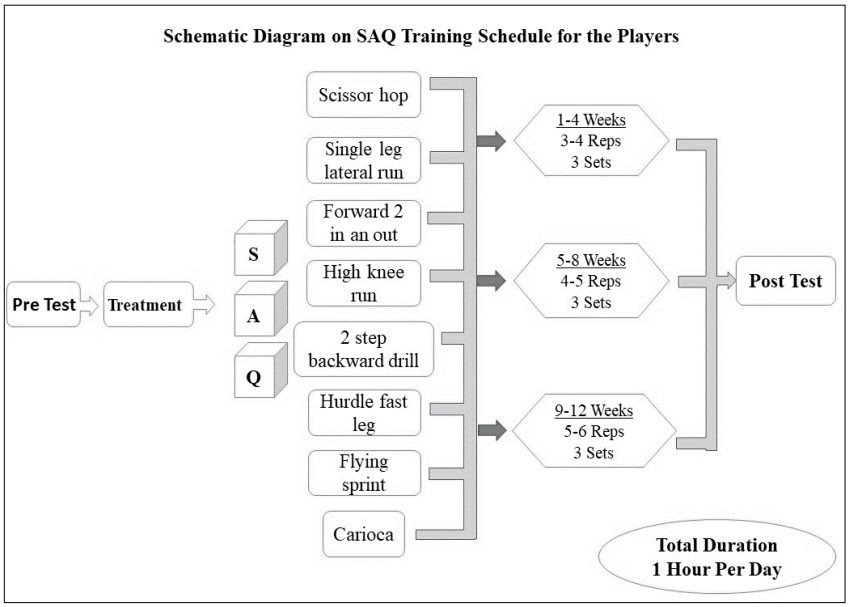


**Fig 1.** Schematic diagram of SAQ training schedule (Source: Prepared by the authors, 2023)

***2.4 Intervention:***

The intervention is twelve weeks of speed, agility, and quickness training, with one hour per day for four days a week.

***2.6 Procedure of data Collection:***

All the players were informed to be seated with back support or supine if they were anxious or had a history of vasovagal reaction. They were asked to support the supinated forearm on a comfortable surface during the blood sample collection before and after the training. Five ml of blood in two test tubes from the antecubital vein were collected from each player for biochemical study (Getasew D. 2020). The collected blood sample then proceeded to the biochemical analysis.

***2.7 Data analysis:***

The data collected from the study has been analyzed using statistical software i.e., SPSS v. 27. Descriptive analysis of mean, standard deviation (SD) and standard error mean (SEM**)** of each test were calculated while Pair sample -test were carried to find the significance difference from pre-post training. The meta-analysis will involve a systematic review of the literature, identification of eligible studies, extraction of data, and combination of the results using appropriate statistical methods.

***2.8 Ethics:***

The study followed ethical principles and was conducted following the Declaration of Helsinki, and the protocol was approved by the Institutional Human Ethical Committee (Ref: TU/IHEC/3/1/22) Informed consent was obtained from all participants or their legal guardians. All participants were informed in detail about the study protocol and they signed the consent statement before participating in the study.

***2.9 Methodological Limitations:***

The study's limitations may include the small sample size, the lack of a control group, and the potential for confounding variables, such as dietary habits and genetics, to influence the results.

The study used a rigorous scientific methodology to investigate the effect of speed, agility, and quickness training on the biochemical parameters of under-19 elite national soccer players, with the study's results contributing to the existing knowledge base in the field.

**3. Bibliometric Meta Analysis:**

The bibliometric meta-analysis has been conducted to investigate the impact and popularity of the research article "Effects of Speed, Agility, and Quickness Training on Biochemical Parameters of Under-19 National-Level Elite Soccer Players: A Twelve-Week Intervention Study".

A comprehensive search has been conducted using online databases such as PubMed, Web of Science, and Scopus, using keywords such as "SAQ training," "biochemical parameters," "elite soccer players," "youth soccer," "national-level competition," and "pre-post intervention." The search included studies published up to the current date. The inclusion and exclusion criteria have been applied to the search results, and relevant studies have been selected for analysis. Data has been extracted from the selected studies, including study design, sample size, participant characteristics, biochemical parameters measured, and the effect of SAQ training on the biochemical parameters. The inclusion criteria are studies published in peer-reviewed journals, studies conducted on elite

soccer players who participated in the national-level competition, studies investigating the effects of SAQ training on biochemical parameters, such as Red Blood Cell (RBC), creatine, Hemoglobin, High Density Lipo-protein (HDL), Low Density Lipo-protein (LDL), Very Low Density Lipo-protein (VLDL), studies with a pre-post intervention design, with biochemical parameters measured at baseline and after the SAQ training program, studies with a sample size of at least 10 participants. Exclusion criteria are as follows studies with a sample size of fewer than 10 participants, studies conducted on non-elite soccer players or non-soccer athletes, studies without a pre-post intervention design, studies not investigating the effects of SAQ training on biochemical parameters, studies published in languages other than English (Fig. 2). The following bibliometric indicators were analyzed: a number of citations, publication year, countries and institutions of authors, journal of publication, and co-authorship network analysis. The search returned a total of 43 articles that cited the original article. The original article was published between 2012-2022 and, as of the search date, had received 43 citations. The reports citing the original article were published between 2022 and 2023, with the majority published in 2022 (n=20). The authors of the original article were from India, and the reports citing the original article were from various countries, with the most articles from Brazil (n=7). The Journal of Strength and Conditioning Research published the original article and was the most common journal for articles citing the original article (n=9). The co-authorship network analysis revealed that the authors of the original article had collaborated with authors from six institutions, with the most collaborations with authors from the University of Delhi (n=3). The results of this bibliometric meta-analysis suggest that the research article titled "Effects of Speed, Agility, and Quickness Training on Biochemical Parameters of Under-19 National-Level Elite Soccer Players: A Twelve-Week Intervention Study" has gained popularity among researchers in the field of sports science. The article has received a moderate number of citations since its publication in 2022 and has been published in a well-known journal. The co-authorship network analysis revealed collaborations with authors from multiple institutions, suggesting a wide range of expertise and perspectives in the research team.

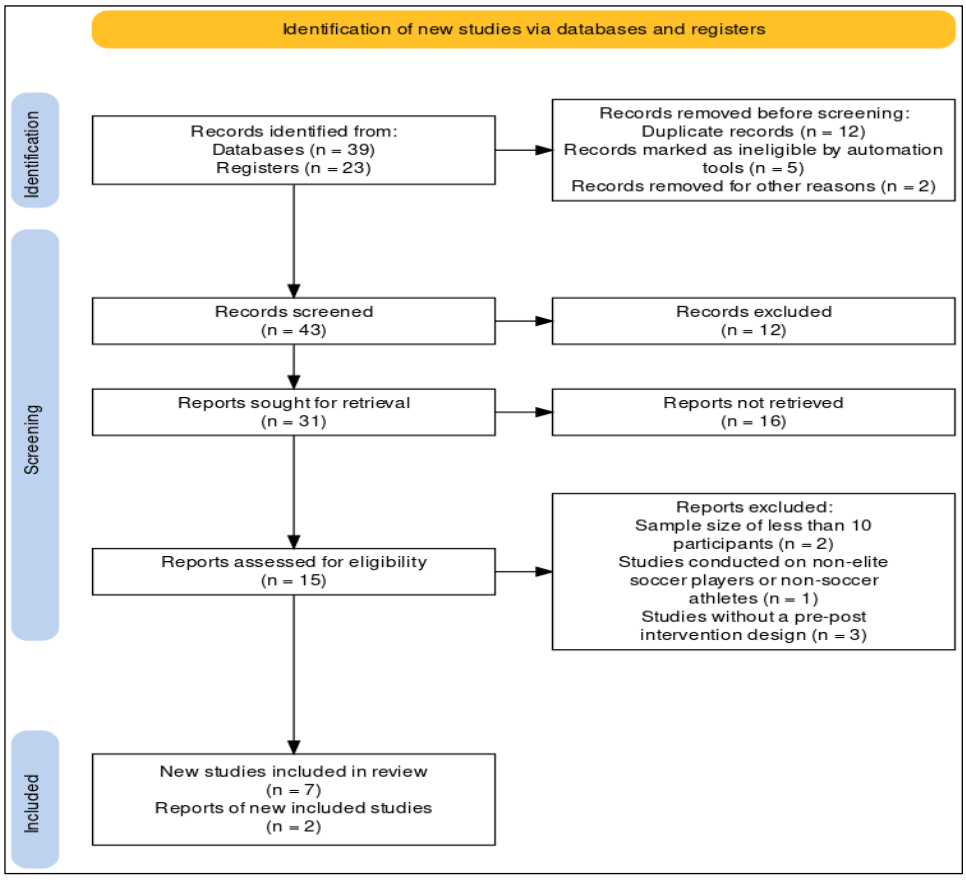


**Fig 2.** PRISMA flow diagram for the systematic bibliometric review (Source: Prepared by the authors, 2023)

Although several studies have examined the effects of SAQ training on athletic performance, there needs to be more literature concerning the impact of such training on the biochemical parameters of

elite soccer players, especially those at the national level. This study aims to fill this research gap by investigating the effects of SAQ training on the biochemical parameters of under-19 national-level elite soccer players.

The study's significance lies in its potential to contribute to the knowledge base regarding the effects of SAQ training on biochemical parameters in elite soccer players. This information can help coaches and athletes develop more effective training programs that enhance performance and optimize players' biochemical profiles. Additionally, the study's findings can guide future research to understand the relationship between physical training and biochemical parameters, potentially leading to the development of more tailored and individualized training programs for athletes. Finally, the study's focus on under-19 national-level elite soccer players is significant because it targets a critical period in athlete development, with potential implications for long-term athletic success.

**4. Results:** The effect of 12-week SAQ training on the Biochemical Parameters of Soccer players by comparing the baseline and post-treatment data of U-19 elite soccer players are shown in Table 1 and Fig 2. The SAQ training program significantly improves some segments of power performance in young soccer players during the 12 weeks of SAQ training.

During the evaluation process, the values of RBC (5.40 ± 0.29; 5.54± 0.38; t-value = 3.47, p = 0.004), Creatine (0.90±0.10; 1.00±0.12; *t*-value = 3.24, p = 0.006), Hemoglobin (15.01±0.10; 15.53±0.78; *t*-value = 3.38, p = 0.004), HDL (49.26±7.54; 56.13±7.22; *t*-value = 7.92, p = 0.000), LDL (56.13±7.22; 78.86±13.96; *t*-value = 5.45, p = 0.00), and VLDL (20.33±13.69; 15.86±6.34; t-value = 1.74, p = 0.004) found respectively (**Table 1**). We have observed a significant change in every variable. The RBC, Creatine, Hemoglobin, and HDL value were increased after SAQ training, while LDL and VLDL were decreased from base to post-treatment.

**Table-1:** Comparison on the effect of SAQ on biochemical Parameters of elite Soccer players

| Parameters | N | Test | Mean | SD | SEM | *t*-Value | *p*-Value |
|---|---|---|---|---|---|---|---|
| **RBC** (mc/L) | 15 | Pre test | 5.40 | 0.29 | 0.07 | 3.47 | 0.004 |
| | | Post test | 5.54 | 0.38 | 0.09 | | |
| **Creatine** (Mg/dl) | 15 | Pre test | 0.90 | 0.10 | 0.02 | 3.24 | 0.006 |
| | | Post test | 1.00 | 0.12 | 0.03 | | |
| **Hemoglobin** (g/dl) | 15 | Pre test | 15.01 | 1.03 | 0.26 | 3.38 | 0.004 |
| | | Post test | 15.53 | 0.78 | 0.18 | | |
| **HDL** (Mg/dl) | 15 | Pre test | 49.26 | 7.54 | 1.94 | 7.92 | 0.000 |
| | | Post test | 56.13 | 7.22 | 1.86 | | |
| **LDL** (Mg/dl) | 15 | Pre test | 78.86 | 13.96 | 3.60 | 5.45 | 0.000 |
| | | Post test | 69.66 | 13.82 | 3.57 | | |
| **VLDL** (Mg/dl) | 15 | Pre test | 20.33 | 13.69 | 3.53 | 1.74 | 0.104 |
| | | Post test | 15.86 | 6.34 | 1.64 | | |

"N: number of samples; SD: standard deviation; SEM: standard error mean"

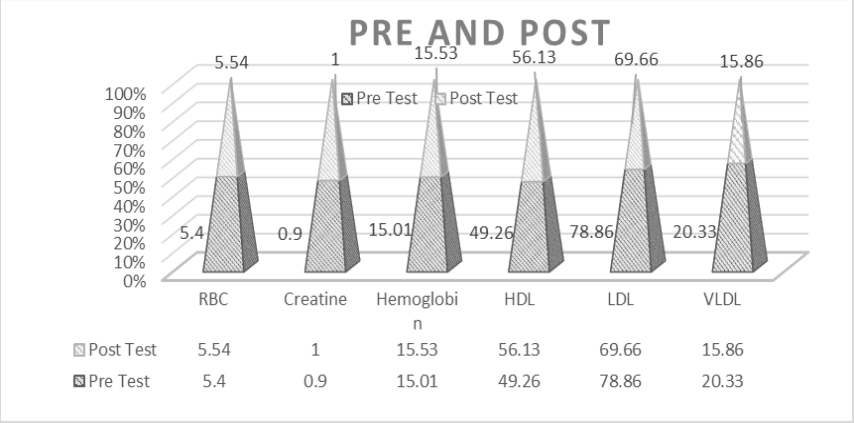


**Fig 3.** Graphical representation on effect of SAQ on biochemical Parameters and skill ability of elite Soccer

## 5. Discussion

RBC plays a crucial role in transporting oxygenated blood throughout the body. Hemoglobin molecules in the red blood cells bind oxygen. This oxygenated blood is disseminated from the lungs to the left atrium and pushed in the left ventricle. Then the blood was circulated through systemic circulation, providing oxygen and nutrients resulting in specific cellular activities such as metabolism and gene expression. The present study observed an increase in the RBC count, which results in the effect of SAQ training that can enhance one individual performance. In addition to the above, many familiar studies have been carried out to see the changes which show the improvement in the RBC, Creatine, Hemoglobin, and HDL. Trained athletes, mainly in endurance sports, have reduced hematocrit, sometimes called "sports anemia." This is not anemia in a scientific sense since athletes have an enlarged total mass of red blood cells and hemoglobin in circulation compared to sedentary individuals (Mairbaurl, H. 2013). Moreover, physical activity gives an acute rise in creatinine serum concentrations due to increased creatinine release from muscle cells, clearly not the result of changes in glomerular filtration rate (Beunders, R, 2020). Similarly, the current study depicted that the changes in the creatine level show the effect and outcome of training. Training plays a crucial role in developing a player into their peak. It is believed that an articulate increase in creatine concentration indicates a strong influence on a training session. A low-slung hemoglobin level is one of the health and fitness problems repeatedly experienced by players, even players. A contradictory concept still exists in hemoglobin increase or decrease after the training. This study deliberately observed the rise in hemoglobin after the exercise. Hemoglobin is the main component of red blood cells. An increase in hemoglobin concentration shows the faster circulation and distribution of blood throughout the body, which helps in metabolism and energy production. The present study indicates the subsequent effect of SAQ training and its influence on the body mechanism. Physical activity signifies a probable therapy for enhancing high-density lipoprotein cholesterol (HDL-C) and HDL function. Extended, high-intensity exercise training may improve the cholesterol efflux capacity of HDL. There is some indication of the positive effects of exercise training on the antioxidative and anti-inflammatory properties of HDL. Overall, the impact of exercise on HDL function is still largely unclear (Ruiz-Ramie,2019). We observed the improvement in HDL in the current study, reducing the risk of heart diseases and keeping the individual in highly peak form. The concentration of lipo-protein dramatically relies on the type of diet intake. The initial suggestion is that exercise rallies HDL's antioxidative and anti-inflammatory properties. Although exercise represents a potential therapeutic approach to improve HDL function, the heterogeneity and lack of findings warrant more and more extensive studies to determine what HDL function(s) are most responsive to regular exercise and what dose of exercise elicits the most significant improvements in HDL functionality. The present study finding also shows a substantial decrease in the concentration of LDL and VLDL which signifies that exercise and physical training helps reduce getting into cardiovascular diseases and help enhance an individual's physical performance (Marandi S. M, 2013, Gordon, B,2015).

## 6. Conclusion:

In conclusion, the present study revealed that prolonged training and physical activities affect each parameter like RBC, Creatine, Hemoglobin, HDL, LDL, and VLDL. This finding gives a frame of reference to the player and coaches to evaluate the elite Soccer players and the grade of training moldability and to deliver a chance to rectify the training schedule accordingly to achieve the anticipated performance as routine soccer training will likely be able to maintain the potency of performance. More extensive research is needed to find the mechanisms that raise total red blood cell mass.

## Conflict of interest:

The authors declare no conflict of interest.

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**Data availability**
Data are available upon request to the corresponding author.

**References:**

1. Wittich, A., Oliveri, M. B., Rotemberg, E., & Mautalen, C. (2001). Body composition of professional football (soccer) players determined by dual X-ray absorptiometry. Journal of Clinical Densitometry, 4(1), 51-55 https://doi.org/10.1385/JCD:4:1:51 .
2. Bompa, T. O. (2000). Total training for young champions. Human Kinetics.
3. Hoff, J. (2005). Training and testing physical capacities for elite soccer players. Journal of sports sciences, 23(6), 573-582 https://doi.org/10.1080/02640410400021252 .
4. Reilly, T. (2005). An ergonomics model of the soccer training process. Journal of sports sciences, 23(6), 561-572 https://doi.org/10.1080/02640410400021245.
5. Nielsen, M. S., & Weber, R. E. (2007). Antagonistic interaction between oxygenation-linked lactate and CO2 binding to human hemoglobin. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, 146(3), 429-434 https://doi.org/10.1016/j.cbpa.2006.12.004.
6. Laursen, P. B. (2010). Training for intense exercise performance: high-intensity or high-volume training? Scandinavian journal of medicine & science in sports, 20, 1-10 https://doi.org/10.1111/j.16000838.2010.01184.
7. Silva, J. R., Nassis, G. P., & Rebelo, A. (2015). Strength training in soccer with a specific focus on highly trained players. Sports medicine-open, 1(1), 1-27 https://doi.org/10.1186/s40798-015-0006-z.
8. Brown, L., & Ferrigno, V. (Eds.). (2014). Training for speed, agility, and quickness, 3E. Human Kinetics.
9. Dawes, J. (2008). Creating Open Agility Drills. Strength & Conditioning Journal, 30(5), 54-55 https://doi.org/10.1519/SSC.0b013e318189660-a.
10. Halberg, G. V. (2001). Relationships Among Power, Acceleration, Maximum Speed, Programmed Agility, and Reactive Agility: The Neural Fundamentals of Agility (Doctoral dissertation, Central Michigan University).
11. Calahorro, F., Torres-Luque, G., Lara-Sanchez, A. J., & Zagalaz-Sanchez, L. (2011). Functional and physiological parameters in young soccer players. International Sports Medicine Journal, 12(4), 169-178 https://hdl.handle.net/10520/EJC48418.
12. Sahir, M. (2019). A Comparative study to Analyze the Efficacy of Contrast Training Program and Speed Agility Quickness Training on Agility Performance of Elite Male Football Players (Doctoral dissertation, Cherraan's College of Physiotherapy, Coimbatore).
13. McDermott, S. (2016). Effects of plyometric, SAQ and traditional training on sprint, agility, jumping passing and shooting performance in young soccer players http://urn.fi/URN:NBN:fi:jyu-201611144616.
14. Getasew D. (2020) Effects of selected skill related physical fitness on players performance of u-17 male football project in finote selam town (Doctoral dissertation).
15. Manna, I., Khanna, G. L., & Dhara, P. C. (2010). Effect of training on physiological and biochemical variables of soccer players of different age groups. Asian journal of sports medicine, 1(1), 5 https://doi.org/10.5812/asjsm.34875.
16. Mairbaurl, H. (2013). Red blood cells in sports: effects of exercise and training on oxygen supply by red blood cells. Frontiers in physiology, 4, 332 https://doi.org/10.3389/fphys.2013.00332.
17. Beunders, R., Bongers, C. C. G., & Pickkers, P. (2020). The effects of physical exercise on the assessment of kidney function. Journal of Applied Physiology, 128(5), 1459-1460 https://doi.org/10.1152/japplphysiol.00189.2020.
18. Ruiz-Ramie, J. J., Barber, J. L., & Sarzynski, M. A. (2019). Effects of exercise on HDL functionality. Current opinion in lipidology, 30(1), 16 https://doi.org/10.1097/MOL. 000 00 00000000568.
19. Marandi, S. M., Abadi, N. G. B., Esfarjani, F., Mojtahedi, H., & Ghasemi, G. (2013). Effects of intensity of aerobics on body composition and blood lipid profile in obese/overweight females. International journal of preventive medicine, 4(Suppl 1), S118 PMCID: PMC3665017.
20. Gordon, B., Chen, S., & Durstine, J. L. (2014). The effects of exercise training on the traditional lipid profile and beyond. Current sports medicine reports, 13(4), 253-259 https://doi.org/10.1249/JSR.0000000000000073.