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ORIGINAL SCIENTIFIC ARTICLE

EFFECT OF SPEED AGILITY QUICKNESS AND CIRCUIT TRAINING ON LIPID PROFILE OF SOCCER PLAYERS: AN OBSERVATIONAL STUDY

SM Farooque[1ABCDE], Mukesh Mitra[2BDE], and Prasanta Kumar Das[1ADC]

[1]Tripura University
[2]Michael Madhusudan Dutta College

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Corresponding Author: Farooque SM, E-mail: smharish9@gmail.com
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Abstract

Study purpose. This observational study aims to investigate the impact of a Speed Agility Quickness (SAQ) and Circuit training program on the lipid profile of soccer players. The study focuses on analyzing changes in high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very-low-density lipoprotein (VLDL) cholesterol concentrations after the intervention.

Materials and methods. The study involved a total of 30 elite soccer players with the mean (Sd) of age 16.93 (1.20) years; stature 5.66 (0.16) feet; weight 59.93 (5.47) kg. All the players selected for the study were registered players of Poloi Academy, Imphal, Manipur. The participants were divided into two groups, i.e., the SAQ and Circuit groups, and underwent a 12 weeks SAQ and Circuit training program respectively, which was conducted 3 days per weeks. Blood samples were collected before and after the intervention to measure HDL, LDL, and VLDL cholesterol levels. The participants' lipid profiles were assessed using standard laboratory techniques.

Results. The results of this study demonstrated significant changes in the lipid profiles of the elite soccer players following the SAQ and Circuit training program. The intervention resulted in a significant increase in HDL cholesterol levels. Simultaneously, there was a substantial decrease in LDL and VLDL cholesterol concentrations.

Conclusions. The increase in HDL cholesterol and reduction in LDL and VLDL cholesterol levels indicate a potential decrease in the risk of cardiovascular diseases and related health issues. Considering the importance of lipid metabolism in athletic performance and overall well-being, this study provides valuable insights for coaches, athletes, and sports professionals in designing targeted training regimens to optimize cardiovascular health among soccer players. However, further research with larger sample sizes and long-term follow-ups is warranted to validate and generalize these findings across diverse populations and sports disciplines.
Keywords: HDL, LDL, VLDL, SAQ, Cholesterol, Circuit.

Introduction

Lipid profile and its metabolism plays a crucial role in the body's overall health and energy balance. It involves the complex processes of lipid digestion, absorption, transport, and utilization, which are regulated by various factors, including diet, physical activity, and genetics (Farooque, Mitra, et al., 2023). In recent years, there has been a growing interest in exploring the impact of different exercise modalities on lipid metabolism to optimize overall health and athletic performance. Blood lipoproteins are formed by various amounts of cholesterol (C), triglycerides (TGs), phospholipids, and apolipoproteins (Apos). ApoA1 is the major structural protein of high-density lipoprotein (HDL), accounting for ~70% of HDL protein, and mediates many of the antiatherogenic functions of HDL (Farooque, Das, et al., 2023). Conversely, ApoB is the predominant low-density lipoprotein (LDL) Apo is an indicator of circulating LDL, associated with higher coronary heart disease (CHD) risk (Muscella et al., 2020a). During exercise and sports activities, both fat and carbohydrates play an important role as primary sources of fuel for the body (Azmi & Kusnanik, 2018). The body relies on four major internal sources of energy during exercise: glucose in the bloodstream, derived from liver glycogenolysis; free fatty acids (FFAs) released from adipose

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tissue lipolysis and the hydrolysis of triacylglycerol (TG) in very low-density lipoproteins (VLDL-TG); muscle glycogen stored within the skeletal muscles; and intramyocellular triacylglycerols (IMTGs) present within the muscle fibers (Rui, 2014; Muscella et al., 2020a).

During low-to-moderate intensity exercises and prolonged physical activity, the majority of energy demands for skeletal muscles are met through the oxidation of fatty acids (FA), with a minor contribution from glucose oxidation (Marandi et al., 2013; Hargreaves & Spriet, 2020). As exercise intensity increases, the reliance on fat as an energy source continues to grow until it reaches approximately 60-65% of $\dot{V}O_2max$ or 74% of the maximum heart rate (Prins et al., 2023). As exercise intensity escalates, there is a notable alteration in the mobilization and utilization of energy substrates (Coyle, 1995). This change involves an increase in the relative reliance on carbohydrate oxidation to meet energy demands, accompanied by a simultaneous decrease in the relative contribution of fat oxidation. This shift in substrate utilization occurs as physical activity transitions from moderate to high intensity (Ramadoss et al., 2022). During the course of exercise, the source of fatty acids (FA) utilized also undergoes changes. At 25% of $\dot{V}O_2max$, the oxidized fat mainly comes from plasma FA (Farooque, Mitra, et al., 2023). However, as exercise intensity reaches 65% of $\dot{V}O_2max$, the contribution of plasma FA decreases, and there is a notable increase in the oxidation of intramyocellular triacylglycerols (IMTG), providing approximately half of the FA used for overall fat oxidation moderate-intensity exercise, the heightened demand for FAs is met through increased lipolysis of adipose tissue triacylglycerols (TGs) (Purdom et al., 2018; Mika et al., 2019). This rise in adipose tissue TG lipolysis, and potentially IMTG utilization, is mediated by an augmented response of catecholamines to exercise (Liu et al., 2020). During physical exercise, both lipids and carbohydrates are oxidized at the same time, although their proportional contributions as fuel sources are controlled by a variety of circumstances (Brun et al., 2022; Pi et al., 2023). These variables include the type of exercise undertaken, the length of the exercise session, and the level of physical activity (Gordon et al., 2014a). Based on these characteristics, the body dynamically modifies its utilization of fats and carbs to fulfil the energy demands of the specific exercise or sport being performed (Mul et al., 2015).

Speed, agility, and quickness (SAQ) training, along with circuit training, have gained popularity as effective exercise approaches to enhance various aspects of physical fitness, such as cardiovascular endurance, muscular strength, and agility (Farooque, Das, et al., 2023). These training methods involve high-intensity, intermittent activities that challenge multiple physiological systems simultaneously, potentially influencing lipid metabolism. However, limited research has been conducted to investigate the specific effects of SAQ and circuit training on lipid metabolism. Understanding the relationship between exercise modalities and lipid metabolism is essential as lipid abnormalities are a significant risk factor for various metabolic disorders, including obesity, dyslipidemia, and cardiovascular diseases. Identifying exercise protocols that can positively impact lipid metabolism may offer valuable insights for developing targeted exercise interventions to prevent and manage these health conditions.

Therefore, this cross-sectional study aims to examine the potential effects of Speed, Agility, and Quickness training and circuit training on lipid metabolism over elite soccer player of Manipur. By elucidating the relationship between exercise modalities and lipid metabolism, this study seeks to contribute valuable information to the fields of exercise science, sports performance, and public health. Furthermore, the findings may have practical implications for exercise prescription and designing personalized training programs aimed at optimizing lipid profiles and promoting overall health and well-being.

Materials and method

Study participants

A purposive sampling technique was used to select the total no. of thirty (N=30) under 19 player who are currently participated in different junior national level tournament i.e., SM Cup, SGFI. The age range of the selected players were between U-16 to U-19 with the mean (Sd) of age 16.93 (1.20) years; stature 5.66 (0.16) feet; weight 59.93 (5.47) kg. All the players selected for the study were registered player of Poloi Academy, Imphal, Manipur. In addition of the above they are currently participating in different national and state level tournaments. The study protocol was retained for every participant. All the selected players for the study underwent the Speed, Agility, Quickness (SAQ) and Circuit training for 12 weeks after the baseline data collection. 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. Further the selected players were divided into two different groups for further treatment and to follow up the design of the study. As the study directed towards the two group of SAQ and Circuit training total players were divided in fifteen (n=15) each for two different group. SAQ group were given the name of Group I and Circuit group were name as Group II. Group I consisted of fifteen (n = 15) with the mean (Sd) of age 17.00 (1.31) years, weight 61.87 (5.94) kg, height 5.67 (0.17) ft. Group II comprised of fifteen (n = 15) with the mean (Sd) of 16.87 (1.13) years, weight 57.88 (4.22) kg, height 5.64 (0.15) ft. After the baseline collection of data both the group underwent the training of 12 weeks in the training ground of Poloi Academy under same environment condition. Training was given after the baseline collection of data on the following variables of lipid such as High-density lipoprotein, Low density lipoprotein, very low-density lipoprotein. Further the training was continued for 72 days as a formal procedure of the study (Farooque, Das, et al., 2023). The data were collected from both the group by following proper protocol of collection procedure.

Training protocol

The training program consist of SAQ and Circuit training Group. The training was given in the morning start from 7.00 am and continued till 8.30 am (warming up and limbering down). The training program were conduct 3 days per week for whole duration of 12 weeks (Luo et al., 2023). In every day training session, the work out was lasted for one (01) hour, which excluded warming up and limbering down. The recovery time in between of repetition was incomplete and in between of sets was complete recovery. The progressive load principle was adopted.

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 (Kostrzewa-Nowak et al., 2015). The collected blood sample then proceeded to the biochemical analysis (SRL Diagnostic Centre, Imphal Manipur). Further the data has been uploaded to Excel for different analysis and inference.

Statistical analysis

Experimental data were further analyzed descriptively for explaining the various status of presented sample in the study. Pair sample -test were employed to find the significance difference from pre to post training of SAQ and Circuit group. The level of significance was set at 0.05.

Results

The level of changes in the HDL after SAQ training on the soccer player has been shown in table 1 which indicates the significant changes in the mean value and SD from pre (49.26±7.54) to post (56.13±7.22) respectively. Further the result has been compared by using pair sample t test which revealed the t value of 7.92 which significant at .000 at significance level of 0.05 and the determinative power of significant difference in this analysis was 100%. Additionally, LDL and VLDL has also shown the significant reduction from their pre data to post data which the positive determination in the hormonal changes of our body and indicating the positive sign of the training effect. The results in the table 1 shown a reduction value in mean value and SD in both variables i.e., mean and SD value of pre and post for LDL were (78.86±13.96) and (69.66±13.82) whereas the pre and post value of VLDL were (20.33±13.69 and 15.86±6.34 respectively). In the light of comparison among the pre and post HDL have shown a significant difference with a t value of 5.45 that is significant at p=0.000 but the VLDL have shown an insignificant difference when compared to pre and post data with a p=0.104 which is not significant at 0.05 level.

Evident shown by the table 2 on HDL shown a significant increase from pre to post (54.60±8.50) and (60.53±10.22). Further shown a significant t value of 9.93 in compare to pre and post which is significant at 0.05 level. The study shown a significant reduction in the mean value from pre to post in case of LDL which shown positive effect on the changes of lipid parameters. The mean value of LDL from pre to post were (65.53±21.97) and (57.80±17.73) respectively. The result has been compared to find the significant difference and the t value of 3.19 was observed with significant value of p=0.006. the mean value and Sd observed for pre and post of VLDL were (16.20±4.57) and (13.73±4.16) respectively. In addition, significant difference was also observed at 0.05 level of significance.

Discussion

The result of the study shows that implementation of 12 weeks SAQ and Circuit training on young football players shows and increased in the concentration and production of HDL, and decreased in LDL and VLDL. The increase in HDL and decrease in LDL and VLDL levels indicate improved cardiovascular health, which can contribute to better athletic performance and long-term well-being. In support of the present study, (Muscella et al., 2020b) reported over a study involving 10 men aged between 46 and 62 years to investigate the effects of endurance exercise training on plasma lipoproteins. The participants underwent a training program consisting of exercise at intensities ranging from 50% to 85% of their maximum oxygen consumption (VO_2max) for 3 to 5 days per week over a period of 29 to 57 weeks. The results of the study revealed several "antiatherogenic"

Table 1. Comparison on the effect of SAQ training program on lipid Profile

Parameters	N	Test	Mean	SD	SEM	t-Value	p-Value	% of Change
HDL	15	Pre test	49.26	7.54	1.94	7.92	.000	15%
		Post test	56.13	7.22	1.86			
LDL	15	Pre test	78.86	13.96	3.60	5.45	.000	12%
		Post test	69.66	13.82	3.57			
VLDL	15	Pre test	20.33	13.69	3.53	1.74	.104	14%
		Post test	15.86	6.34	1.63			

Table 2. Comparison on the effect of Circuit training program on lipid Profile

Parameters	N	Test	Mean	SD	SEM	t-Value	p-Value	% of Change
HDL	15	Pre test	54.60	8.50	2.19	9.93	.000	11%
		Post test	60.53	10.22	2.64			
LDL	15	Pre test	65.53	21.97	5.67	3.19	.006	11%
		Post test	57.80	17.73	4.57			
VLDL	15	Pre test	16.20	4.57	4.57	6.34	.000	15%
		Post test	13.73	4.16	1.19			

benefits of exercise training. The training program led to significant increases in levels of high-density lipoprotein cholesterol (HDL-C) and the ratio of HDL-C to low-density lipoprotein cholesterol (LDL-C) (HDL-C/LDL-C) (Cho et al., 2023). Additionally, plasma cholesterol (C), LDL-C, and triglyceride (TG) concentrations decreased following the exercise regimen. These beneficial changes in lipoprotein levels were attributed to the training program, as they were strongly correlated with improvements in the participants' maximum oxygen consumption (VO_2max), which indicates improved cardiovascular fitness.

Furthermore, the positive effects of moderate-intensity endurance activity on lipoprotein profiles were observed not only in healthy individuals but also in patients with conditions such as ischemic heart disease, diabetes, and renal failure. The study demonstrated that endurance exercise training, performed at moderate to high intensities and regular frequencies, leads to favorable changes in plasma lipoproteins, particularly an increase in HDL-C levels and improvements in the HDL-C/LDL-C ratio. These findings highlight the importance of incorporating regular endurance exercise in promoting cardiovascular health in both healthy individuals and those with certain medical conditions. Meanwhile, the statistical findings of present study implies that the SAQ and Circuit training program of 12 weeks has significantly improved the HDL level from pre to post training in football players. It shows a significant trend in the changing pattern of HDL over football players. It indicates that regular exercise has positive influence on lipid profiles, including HDL levels. Training such as SAQ and circuit training, are particularly effective in raising HDL levels. These types of exercises involve continuous movement, increased heart rate, and prolonged energy expenditure, which can improve cholesterol metabolism and increase HDL production. The significant improvement in HDL levels observed in the study suggests that the 12-week SAQ and Circuit training program had a positive impact on cardiovascular health of soccer players. The specific combination of exercises, intensity, and duration likely contributed to the observed results. However, it's important to recognize that individual responses to exercise-induced changes in HDL levels may vary. Factors such as sample size, genetics, baseline fitness, dietary habits, and other lifestyle factors can influence how individuals respond to training interventions. It would be valuable to replicate the study with a larger sample size, control group, and longer follow-up to assess the long-term sustainability of the HDL improvement. According to (Rosenkilde et al., 2018) reported that the changes occur in HDL and lipid plasma are higher in men after considerably exposed in physical training. It has been suggested that relationship between the changes occur after the exercise might be of triglycerides metabolism. Free fatty acids are the major energy source during prolong endurance activity and HDL is intimately involved in fat metabolism (Farooque, Mitra, et al., 2023). This exercise induces and changes in the lipo-protein might be because of the adaptation to replenish intra-muscular free fatty acids used during exercises. Even the present study shows a greater effect of Circuit training (which purposively construct endurance form of activity) on HDL concentration when compare to SAQ training (Speed, Agility and Quickness). According to Despres JP 1991 regular endurance exercise is extensively documented on modality to raise plasma HDL cholesterol levels. In support of the current study, (Sarzynski et al., 2022) reported that HDL cholesterol concentrations have been shown to increase with regular endurance exercise and, thus, can contribute to a lower risk of coronary heart disease in physically active individuals compared to sedentary subjects. In addition, (Ruiz-Ramie et al., 2019) reported from two different studies that individual with high cholesterol level before training increase more when compare to low training group. Some authors even claims that the weight loss associated with exercise training produces the increase in HDL cholesterol (Gordon et al., 2014b).The positive changes in HDL after training has been reported softly by different authors. No studies have been found which defined the actual mechanism of HDL in improving performance. However, it has been reported that HDL accept the excess surface of fatty particles after catabolism of fat for energy production removed through HDL path flow. The higher concentration of HDL in plasma could constrained LDL oxidation which keeps individual safe and sound from getting into heart related risk diseases.

These inconsistent findings suggest that the effects of an endurance training program on TC, TG, LDL-C, and TC/HDL-C may be affected by the length of the training time or other uncontrollable factors. Lin et al. (2015) found that athletes with elevated pre-exercise LDL concentrations responded most favorably to exercise training in a meta-analysis of multiple longitudinal trials. The present study reveals a decrease in the LDL concentration level when compare to pre and post of 12 weeks SAQ and circuit training on soccer players. Both the SAQ and Circuit group has shown significant reduction in LDL concentration level. From the result we can see the certain positive effect on LDL concentration and reduce the risk of sudden cardiac related attack. On the contrary, Previous research revealed that the free and esterified cholesterol of low density lipo-protein show a significant diurnal variation and it was suggested that dietary intake plays major and crucial role in increasing and lowering of the concentration level of LDL (Beunders et al., 2020). A limitation of this study is that dietary intake and nutritional status of the player was not under control as it has given the different variation in the concentration level of LDL in our body. Further, relevant studies in LDL have carried out by different authors which shown ultimate reduction in the concentration of LDL because of the triglyceride's metabolism carried out in the body. A meta-analysis of 170,000 participants were carried out (Navarese et al., 2018), and it suggested that reductions in LDL cholesterol decreased the occurrence of heart attacks and ischemic strokes. Physical activity and different from of training are directly related with reduction of LDL which is very important to sustain for prevention of cardiac diseases. Swiftly, higher intake of oxygen during the training lead to oxidative stress which may be remunerated by higher levels of free radicles scroungers of low molecular mass and by the higher activities of antioxidant enzymes.

VLDL excretion percentage reduced significantly throughout the exercise and persisted on repressing during recovery. Total VLDL-TG oxidation proportion was natural by exercise. However, the contribution of VLDL-TG oxidation to total energy expenditure fell from 14 ± 9% at rest to 3 ± 4% during exercise (Sondergaard et al., 2011).

Further suggested that lesser VLDL exudation degree during exercise may contribute to the decrease in TG concentrations during and after exercise. VLDL-TG fatty acids, on the other hand, are quantitatively significant oxidative substrates under basal post absorptive settings but are unaltered over 90 minutes of moderate-intensity exercise and so become relatively less important during exercise (Sondergaard et al., 2011). Significant reduction in the level of VLDL has been observed in the present study. The pre training results pertained to the VLDL was 20.33±15.86 which reduced to 15.86±6.34 after 12 weeks SAQ training. In case of circuit training significant decrease in the concentration level of VLDL was observed, pre- (16.20±4.57) and post- (13.73±4.16) which is comparatively better than SAQ training. Eventually the effect occurs after the training rely over the different forms of training. Endurance forms of training has certainly impact over the changes of lipo-protein. Here in this study the subject was neither sedentary nor inactive people. All the subjects were elite level players who have improve and develop a certain level of fitness. Even though some exceptional players are still existing which have higher concentration of VLDL in the study.

Conclusion

In the light of the findings the study concludes that the intervention of endurance and speed-based training program improves the concentration of HDL, LDL and VLDL of elite soccer players. The training program led to an increase in the concentration of high-density lipoprotein (HDL) cholesterol. The training program also resulted in a decrease in the concentrations of low-density lipoprotein (LDL) and very-low-density lipoprotein (VLDL) cholesterol. Similarly, elevated levels of VLDL are associated with an increased risk of cardiovascular issues. The decrease in these cholesterol fractions is beneficial for overall cardiovascular health. The study suggests that for elite soccer players to observe significant improvements in their lipid metabolism, the training program should be prolonged, lasting at least more than 8 weeks. This indicates that long-term, consistent training is necessary to achieve substantial changes in cholesterol levels and lipid profiles. The conclusion implies that an appropriately designed endurance and speed-based training program can have substantial benefits on the lipid metabolism of elite soccer players. By increasing HDL levels and reducing LDL and VLDL levels, the program contributes to improved cardiovascular health and lowers the risk of heart-related issues. However, it's important to note that individual responses to the training may vary, and factors such as diet, genetics, and lifestyle also play significant roles in influencing lipid metabolism. Therefore, a holistic approach that includes both exercise and healthy dietary habits is crucial for optimizing the lipid profile and overall health of elite soccer players.

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Conflict of interest

The authors declare no conflict of interest.

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ВПЛИВ ТРЕНУВАНЬ НА ШВИДКІСТЬ, СПРИТНІСТЬ І МОТОРНІСТЬ ТА КОЛОВИХ ТРЕНУВАНЬ НА ВМІСТ ЛІПІДІВ У КРОВІ ФУТБОЛІСТІВ: СПОСТЕРЕЖНЕ ДОСЛІДЖЕННЯ

См Фаррук[1ABCDE], Мукеш Мітра[2BDE], Прасанта Кумар Дас[1ADC]

[1]Трипурський університет
[2]Коледж імені Майкла Модхушудона Дотта

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 2 табл., 29 джерел.

Мета дослідження. Метою цього спостережного дослідження було вивчення впливу програми тренувань на швидкість, спритність і моторність (ШСМ) і кругових тренувань на вміст ліпідів у крові футболістів. Увагу в дослідженні зосереджено на аналізі змін концентрацій холестерину ліпопротеїнів високої щільності (ЛПВЩ), ліпопротеїнів низької щільності (ЛПНЩ) і ліпопротеїнів дуже низької щільності (ЛПДНЩ) після втручання.

Матеріали та методи. У дослідженні взяли участь 30 елітних футболістів із середнім показником (Sd, середнє квадратичне відхилення) віку 16,93 (1,20) року; зросту 5,66 (0,16) фута; ваги 59,93 (5,47) кг. Усі гравці, відібрані для дослідження, були зареєстрованими гравцями Академії Полоі, Імпхал, Маніпур (Індія). Учасників розподілили на дві групи, тобто групу тренувань на ШСМ і групу колових тренувань, і вони пройшли 12-тижневу програму тренувань на ШСМ і колових тренувань відповідно, яку проводили 3 дні на тиждень. Для вимірювання рівнів холестерину ЛПВЩ, ЛПНЩ та ЛПДНЩ збирали зразки крові до та після втручання. Вміст ліпідів у крові учасників оцінювали за допомогою стандартних лабораторних методів.

Результати. Результати цього дослідження продемонстрували статистично значущі зміни у вмісті ліпідів у крові елітних футболістів після проходження програми тренувань на ШСМ і колових тренувань. Втручання призвело до статистично значущого підвищення рівня холестерину ЛПВЩ. Водночас спостерігалося суттєве зниження концентрації холестерину ЛПНЩ та ЛПДНЩ.

Висновки. Підвищення рівня холестерину ЛПВЩ і зниження рівня холестерину ЛПНЩ і ЛПДНЩ вказують на потенційне зниження ризику серцево-судинних захворювань і пов'язаних із ними проблем зі здоров'ям. Беручи до уваги важливість ліпідного обміну для спортивних показників і загального самопочуття, це дослідження забезпечує цінні аналітичні дані для тренерів, спортсменів і спортивних професіоналів у розробці цільових режимів тренувань для оптимізації здоров'я серцево-судинної системи футболістів. Проте для підтвердження валідності та узагальнення цих одержаних результатів для різних контингентів і спортивних дисциплін потрібні подальші дослідження з більшими розмірами вибірки та тривалими наступними спостереженнями.

Ключові слова: ЛПВЩ, ЛПНЩ, ЛПДНЩ, тренування на ШСМ, холестерин, колове тренування.

Information about the authors:

Farooque, Sm: mharish9@gmail.com; https://orcid.org/0000-0003-1018-6745; Department of Physical Education, Tripura University, NH8, University Rd, Suryamani Nagar, Agartala, Madhupur, Tripura 799022, India.

Mitra, Mukesh: golu.wa.mitra@gmail.com; https://orcid.org/0000-0003-2129-8355; Department of Physical Education, Michael Madhusudan Dutta College, Sabroom Station Rd, Paschim Jalefa, Sabroom, Tripura 799145, India.

Das, Prasanta Kumar: rasantadas@tripurauniv.ac.in; https://orcid.org/0009-0006-2831-453X; Department of Physical Education, Tripura University, NH8, University Rd, Suryamani Nagar, Agartala, Madhupur, Tripura 799022, India.

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