Спортивная Медицина: наука и практика

https://doi.org/10.47529/2223-2524.2025.2.3

УДК 796.015.572+ 796.011

Тип статьи: Оригинальная статья / Original Research

Check for updates

CC BY 4.0

Meta-analysis of the effect of high-intensity interval training on improving blood lipid metabolism in female college students

Yu Jun[1], Wang Huan[1,2], Yu Haotong[1,*]

[1]The Russian University of Sports "GTSOLIFK", Moscow, Russia

[2]Jilin Sports University, Changchun, China

ABSTRACT

Purpose of the study: This study used the meta-analysis method to systematically evaluate and compare the intervention effects of HIIT (high-intensity interval training) and MICT (moderate-intensity continuous training) on blood lipid metabolism in obese female college students.

Methods: Publicly published controlled trials on regulating blood lipids with high-intensity interval training were searched through CNKI, Web of science, Scopus, Google Scholar, and Elibrary databases. Meta-analysis was performed on the outcome indicators of 427 subjects in the 7 included articles.

Results: Among the included literature, the number of articles reporting blood lipid health outcomes were: 6 articles for TC, 7 articles for TG, 7 articles for LDL-C, and 5 articles for HDL-C. Studies investigating the effects of HIIT on TC, TG, LDL-C, and HDL-C exhibited low heterogeneity; therefore, a fixed-effects model was used. HIIT significantly improved TC (SMD = -0.71, I^2 = 30.10 %, 95 % CI: -1.05 to -0.38, p = 0.21), TG (SMD = -0.46, I^2 = 38.48 %, 95 % CI: -0.77 to -0.16, p = 0.14), LDL-C (SMD = -0.33, I^2 = 6.13 %, 95 % CI: -0.58 to -0.09, p = 0.38), and HDL-C (SMD = 0.23, I^2 = 2.28 %, 95 % CI: -0.07 to 0.53, p = 0.38).

Conclusion: Compared with MICT, intervention through HIIT training in female college students can effectively improve blood lipid-related indicators such as TC, TG, LDL-C, and HDL-C. This finding can provide theoretical and practical basis for exercise intervention in the physical and mental health development of female college students. However, the study also has some limitations. Due to the constraints of the number of included studies and the complexity of HIIT exercise protocols, the above conclusions still need to be verified by more high-quality RCT to ensure the reliability and applicability of the findings.

Keywords: HIIT, MICT, blood lipid health, university student

Conflict of interests: the authors declare no conflict of interest.

For citation: Yu Jun, Wang Huan, Yu Haotong. Meta-analysis of the effect of high-intensity interval training on improving blood lipid metabolism in female college students. *Sportivnaya meditsina: nauka i praktika (Sports medicine: research and practice).* 2025. https://doi. org/10.47529/2223-2524.2025.2.3

Received: 21 May 2025

Accepted: 14 September 2025

Online first: 08 October 2025

*** Corresponding author**

Sports Medicine: research and practice

Метаанализ влияния высокоинтенсивных интервальных тренировок на улучшение липидного профиля у студенток

Юй Цзюнь[1], Ван Хуань[1,2], Юй Хаотун[1,*]

[1]Российский университет спорта «ГЦОЛИФК», Москва, Россия

[2]Цзилиньский спортивный университет, Чанчунь, Китай

АННОТАЦИЯ

Цель исследования. Систематически оценить и сопоставить эффекты ВИИТ (высокоинтенсивных интервальных тренировок) и НСТСИ (непрерывных тренировок средней интенсивности) на липидный обмен у студенток с ожирением с помощью метаанализа.

Материалы и методы. Путем поиска в базах данных CNKI, Web of Science, Scopus, Google Scholar, Elibrary были отобраны опубликованные рандомизированные контролируемые испытания, посвященные влиянию ВИИТ на липидный профиль. Метаанализ включил данные 427 участниц из 7 исследований.

Результаты. Включенная литература содержала следующее количество статей с данными о показателях липидов крови: 6 статей по ОХ (общий холестерин), 7 статей по ТГ (триглицериды), 7 статей по ЛПНП и 5 статей по ЛПВП. Исследования влияния ВИИТ на ОХ, ТГ, ЛПНП и ЛПВП показали низкую неоднородность, поэтому использовалась модель фиксированных эффектов. ВИИТ достоверно улучшил: ОХ (SMD = -0,71; I^2 = 30,10 %; 95 % ДИ: от -1,05 до -0,38; p = 0,21), ТГ (SMD = -0,46; I^2 = 38,48 %; 95 % ДИ: от -0,77 до -0,16; p = 0,14), ЛПНП (SMD = -0,33; I^2 = 6,13 %; 95 % ДИ: от -0,58 до -0,09; p = 0,38), ЛПВП (SMD = 0,23; I^2 = 2,28 %; 95 % ДИ: от -0,07 до 0,53; p = 0,38).

Заключение. По сравнению с НСТСИ, интервенция с использованием тренировок ВИИТ у студенток позволяет эффективно улучшить показатели крови, связанные с липидами, такие как TC, TG, LDL-C и HDL-C. Это открытие может служить теоретической и практической основой для физической интервенции в развитии физического и психического здоровья студенток. Однако исследование имеет некоторые ограничения. Из-за ограничений, связанных с количеством включенных исследований и сложностью протоколов тренировок ВИИТ, вышеуказанные выводы все еще требуют проверки с помощью большего количества высококачественных рандомизированных контролируемых испытаний (RCT) для обеспечения надежности и применимости полученных результатов.

Ключевые слова: ВИИТ, НСТСИ, здоровье липидов крови, студенты

Конфликт интересов: авторы заявляют об отсутствии конфликта интересов.

Для цитирования: Юй Цзюнь, Ван Хуань, Юй Хаотун. Метаанализ влияния высокоинтенсивных интервальных тренировок на улучшение липидного профиля у студенток. *Спортивная медицина: наука и практика*. 2025. https://doi.org/10.47529/2223-2524.2025.2.3

Конфликт интересов: авторы заявляют об отсутствии конфликта интересов.

Поступила в редакцию: 21.05.2025

Принята к публикации: 14.09.2025

Online first: 08.10.2025

*** Автор, ответственный за переписку**

1. Introduction

In recent years, with the rapid development of Chinese society and economy, the prevalence of lipid metabolism disorders has shown a significant upward trend due to changes in the dietary structure of the population [1]. At present, the disease has broken through the age boundary of traditional cognition, and typical cases of abnormally elevated triglyceride (TG) in adolescents have appeared in the clinic [2]. According to the Report on Nutrition and Chronic Disease Status of Chinese Residents (2020), the prevalence of abnormal lipid metabolism among Chinese residents aged 18 years and above is as high as 35.6 % [3]. Abnormal blood lipid metabolism is primarily characterized by the "three highs and one low" feature: serum total cholesterol (TC) and triglyceride (TG) levels exceeding normal limits, abnormally elevated low-density lipoprotein cholesterol (LDL-C), accompanied by insufficient high-density lipoprotein cholesterol (HDL-C) concentration [4].

Statins remain the primary therapeutic option for managing dyslipidemia in clinical practice. However, their use in cholesterol reduction is associated with reported adverse effects and issues of drug resistance. For instance, the incidence of statin-induced myotoxicity (SIM) ranges from 7 % to 29 % of patients [5]. Prospective studies on drug-induced liver injury indicate that statins account for homotypic liver injury in 1.9 % to 5.5 % of cases [6]. Concerns regarding statin safety are particularly heightened in patients with multiple comorbidities and those on polypharmacy regimens [7]. Consequently, medical researchers continue to explore alternative treatment approaches that offer greater convenience, efficacy, shortened treatment courses, and cost-effectiveness.

Relevant studies have shown that aerobic training helps to regulate blood lipid levels, promote reverse cholesterol transport, effectively regulate the expression of key metabolic enzymes such as lipoprotein lipase (LPL) and hepatic lipase (HL), and then optimise the whole process of synthesis, transport and catabolism of lipoprotein particles, which ultimately significantly reduces the risk of coronary atherosclerotic heart disease [8]. With the wide application and continuous development of exercise therapy in the field of lipid regulation, the metabolic regulation mechanism of HIIT (high-intensity interval training) has gradually become a research hotspot. Unlike traditional MICT (moderate-intensity continuous training), HIIT induces a unique metabolic stress state in the body through an alternating pattern of "high-intensity bursts - intermittent recovery" [9–11]. During the explosive exercise phase, the phosphagen system and glycolytic energy supply are dominant, directly catabolising adenosine triphosphate and phosphocreatine and generating energy rapidly, while lactate is produced, leading to an increase in the local H^+ concentration; during the recovery phase of the intermittent period, aerobic metabolism progressively removes metabolic wastes and replenishes myogenic reserves through the continuous oxidative decomposition of lactic acid, fat and residual glycogen [12]. Repeated activation of the phosphagen system and sustained enhancement of aerobic metabolism contribute to the formation of a specific metabolic stress cycle in the organism. The synergistic effect of different energy supply pathways enables the organism to simultaneously obtain the output of anaerobic metabolism and the persistent adaptive capacity of aerobic metabolism [13]. This increased metabolic flexibility both enhances the persistence of explosive output and promotes a sustained post-exercise energy-consuming effect, constituting a dual metabolic advantage unique to high-intensity interval training.

The novelty of this study lies in the fact that most of the current academic research on HIIT focuses on professional athletes, while relatively few studies have been conducted on college student populations. Based on this, this study will systematically review the existing literature and experimental data through the systematic evaluation and comparison of Meta-analysis, to explore in depth the effect of HIIT on the improvement of lipid metabolism in college students.

2. Materials and Methods

2.1 Data Sources and Search Strategies

Through computerized searches of publicly published randomized controlled trials (RCT) on HIIT interventions for blood lipids in the CNKI, Web of Science, Scopus, Google Scholar, and Elibrary databases, the search period was set from December 2015 to May 2025. Search terms included "HIIT, MICT, blood lipids, TC, TG, LDL-C, HDL-C," etc. Corresponding search strategies were formulated according to each database's characteristics, followed by secondary searches of references in included literature and relevant reviews.

2.2 Inclusion and Exclusion Criteria for Research Materials

Participants were female college students, with no restrictions on ethnicity, disease duration, or comorbidities. For interventions, studies with clear diagnostic criteria, efficacy evaluation standards, and no additional intervention methods were included: the experimental group received HIIT, while the control group received MICT. Primary outcome indicators included TC, TG, HDL-C, and LDL-C; included studies reported at least one of these. Exclusions based on study type: non-RCTs, case reports, expert experience, reading reports, and animal studies. Exclusions based on publication type: reviews, non-Chinese/English/Russian publications, and duplicate publications. Exclusions based on trial process: combined interventions, unclear results, or incomplete data.

2.3 Literature screening, data extraction, and quality assessment

Two researchers independently screened literature according to inclusion/exclusion criteria, reviewing full texts for exclusion decisions. Data extraction was performed for eligible studies. Make three types of assessments (high risk, low risk, and unclear) for each item respectively. Both researchers used self-made extraction forms to independently extract: 1. basic information (first author, publication year, journal, title); 2. experimental/control group details (case numbers, total sample size, age, interventions, duration, outcomes); 3. study design and quality assessment; 4. outcome indicators. Cross-checking was conducted. Discrepancies were resolved through discussion; unresolved cases were arbitrated by an independent third party.

2.4 Statistical Analysis

For continuous variables, the pooled effect size was expressed as the standardized mean difference (SMD). Heterogeneity was tested using the Q-test and the I^2 test, and publication bias was analyzed using Egger's test. If $I^2 < 50\%$, indicating low heterogeneity, the fixed-effect model was used; if $I^2 > 50\%$, indicating significant heterogeneity, the random-effects model was used.

3. Results

3.1 Literature Search Results

An initial search yielded 437 articles. Two reviewers independently screened the literature according to the inclusion and exclusion criteria, from initial screening to full-text review, ultimately resulting in 7 articles (Figure 1). Comprising 427 subjects in total, with sample sizes ranging from 30 to 117 participants. The basic information table of the literature was arranged in ascending order by year of publication. The basic characteristics of the included studies and descriptions of exercise prescriptions are presented (Table 1).

3.2 Bias Risk Assessment

Quality assessment was conducted using the Cochrane risk of bias assessment. Bias risks were evaluated for the following domains: randomization sequence generation, allocation concealment, blinding (outcome assessors, participants), selective reporting, incomplete outcome data, and other biases. Each item was rated as high risk, low risk, or unclear risk. Given the particularity of exercise interventions, most studies did not adopt blinding. All studies showed that the evaluation results of bias in the completeness of outcome indicator data and selective reporting bias were low risk (Table 2).

3.3 Results of Meta-Analysis

Among the included literature, the number of articles reporting blood lipid health outcomes were: 6 articles for

Sports Medicine: research and practice

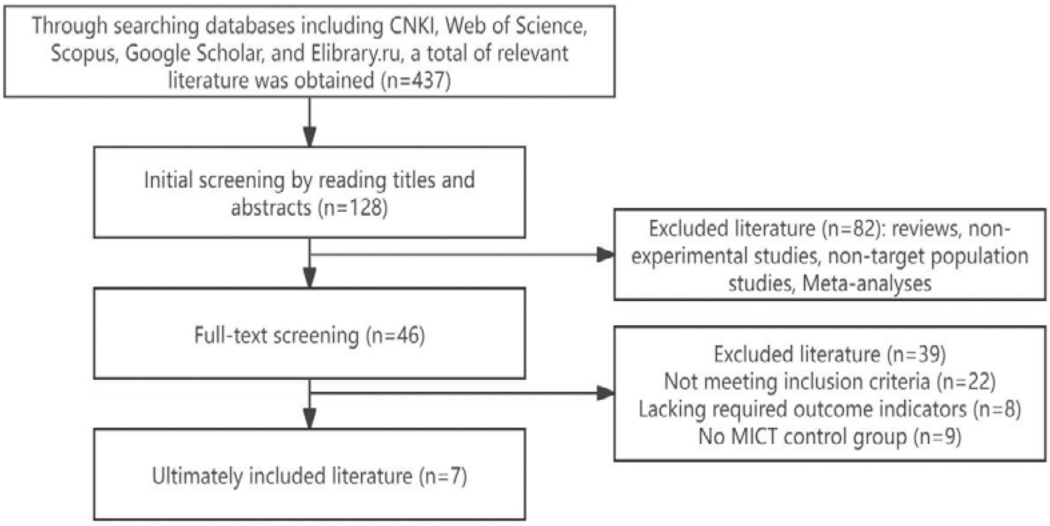

Fig. 1. Literature screening and inclusion process
Рис. 1. Процесс отбора и включения литературы

Table 1

Basic information and description of exercise prescription in the included literature

Таблица 1

Основная информация и описание физической программы во включенной литературе

Study reference	Experimental group				Control group				Treatment duration (weeks)	Outcome measures
	Sample size	BMI	Age	Exercise prescription	Sample size	BMI	Age	Exercise prescription		
Lin Jian 2016[14]	18	29.4 ± 2.0	18~23	90 % HR max 4 min, 70 % HR max 3 min	18	29.7 ± 1.9	18~23	60–70 % HR max, 30–50 min	12	②③
Chi Guijun 2023[15]	32	30.81 ± 2.07	-	≥85 HR max	32	31.16 ± 2.13	-	60–70 % HR max, 40 min	8	①②③④
Liu Chao-hui 2023[16]	26	29.67 ± 1.09	18~20	77–85 % HR max, 86–95 % HR max	26	29.60 ± 1.04	18~20	64–76 % HR max	12	①②③④
Cai Xiaolin 2023[17]	15	31.14 ± 1.59	18~20	90 % HR max	15	31.20 ± 1.69	18~20	60–70 % HR max, 30–50 min	8	①②③
Lu Yining 2023[18]	59	20.92 ± 2.39	18~23	8×20s max intensity, 10s rest between sets	58	21.40 ± 2.37	18~23	60–70 % HR max, 30–50 min	12	①②③④
Wang Peng 2023[19]	22	29.59 ± 1.15	18~20	90–95 % HR max, 2 min	21	30.25 ± 1.44	18~20	60–70 % HR max, 30 min	8	①②③④
Liu Juan 2025[20]	43	24.51 ± 2.35	18~25	1 min high intensity exercise, 1.5 min interval rest	42	26.1 ± 2.19	18~25	Continuous aerobic exercise 30 min/repetition	12	①②③④

Note: HR max — maximum heart rate, min — minute. Outcome indicators: ①TC; ②TG; ③LDL-C; ④HDL-C.
Примечание: HR max — максимальная частота сердечных сокращений, min — минута. Показатели исходов: ①TC (общий холестерин); ②TG (триглицериды); ③LDL-C (ХС ЛПНП); ④HDL-C (ХС ЛПВП).

Table 2

Results of bias risk assessment for included studies

Таблица 2

Результаты оценки риска смещений для включенных исследований

Study reference	Random allocation method	Concealment of allocation method	Blinding		Completeness of outcome data indicators	Selective reporting of study results	Other sources of bias
			Blinding of participants	Blinding of assessors			
Lin Jian 2016[14]	Low risk	Unclear	High risk	Unclear	Low risk	Low risk	Low risk
Chi Guijun 2023[15]	Low risk	Unclear	High risk	Unclear	Low risk	Low risk	Low risk
Liu Chaohui 2023[16]	Low risk	Unclear	High risk	Unclear	Low risk	Low risk	Low risk
Cai Xiaolin 2023[17]	Low risk	Unclear	High risk	Unclear	Low risk	Low risk	Low risk
Lu Yining 2023[18]	Low risk	Unclear	High risk	Unclear	Low risk	Low risk	Low risk
Wang Peng 2023[19]	Low risk	Unclear	High risk	Unclear	Low risk	Low risk	Low risk
Liu Juan 2025[20]	Low risk	Unclear	High risk	Unclear	Low risk	Low risk	Low risk

TC, 7 articles for TG, 7 articles for LDL-C, and 5 articles for HDL-C. Studies investigating the effects of HIIT on TC, TG, LDL-C, and HDL-C exhibited low heterogeneity; therefore, a fixed-effects model was used. HIIT significantly improved TC (SMD = -0.71, I^2 = 30.10 %, 95 % CI: -1.05 to -0.38, p = 0.21) (Figure 2), TG (SMD = -0.46, I^2 = 38.48 %, 95 % CI: -0.77 to -0.16, p = 0.14) (Figure 3), LDL-C (SMD = -0.33, I^2 = 6.13 %, 95 % CI: -0.58 to -0.09, p = 0.38) (Figure 4), and HDL-C (SMD = 0.23, I^2 = 2.28 %, 95 % CI: -0.07 to 0.53, p = 0.38) (Figure 5).

3.4 Publication Bias Analysis

For the included studies, a corrected comparison funnel plot is usually drawn. The results are used to show whether all included literatures are distributed near the central axis of the funnel plot, and the number of literatures on both sides of the central axis is basically symmetric.

However, since the number of indicators included in this study is less than 10, the symmetry of the funnel plot may be difficult to detect, thus there is a risk of neglecting the test for publication bias. To quantitatively assess publication

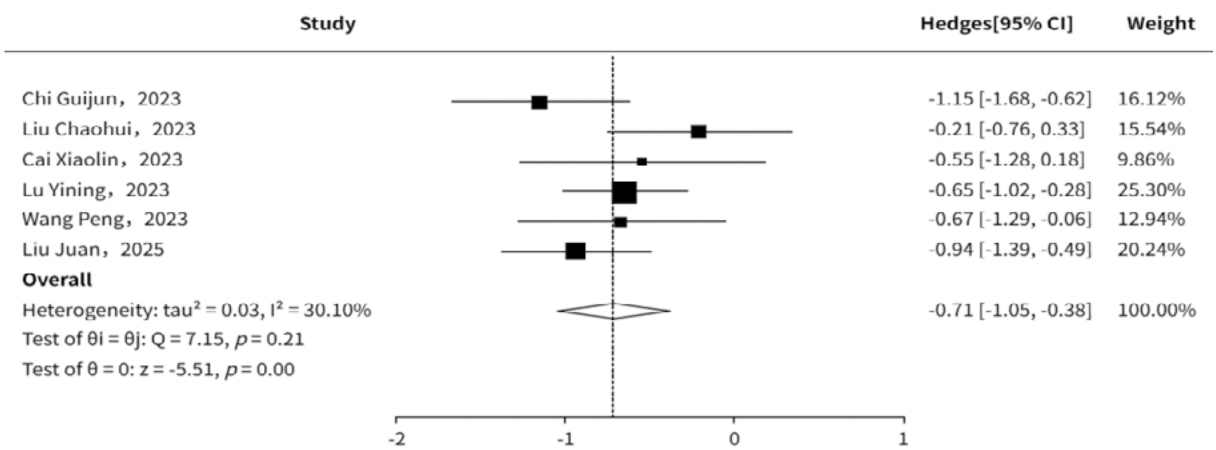

Fig. 2. Forest plot of the effect of HIIT on TC in female college students
Рис. 2. Лесной график влияния ВИИТ на уровень ОХ у студенток

Sports Medicine: research and practice

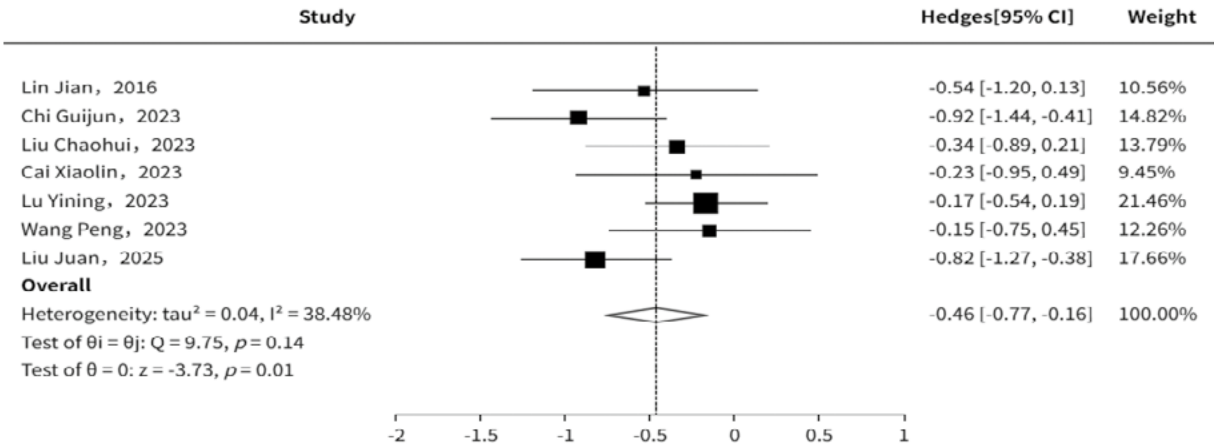

Fig. 3. Forest plot of the effect of HIIT on TG in female college students
Рис. 3. Лесной график влияния ВИИТ на уровень ТГ у студенток

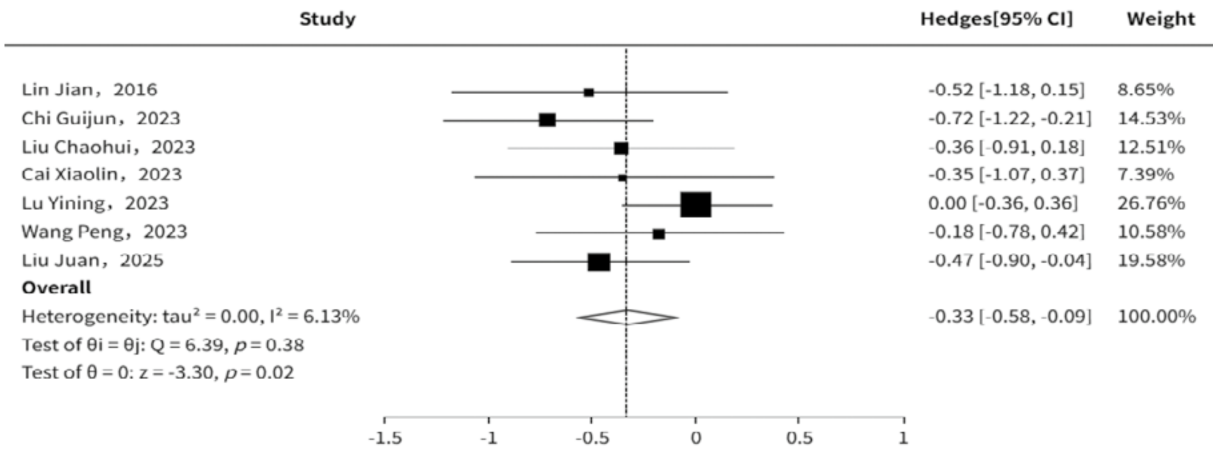

Fig. 4. Forest plot of the effect of HIIT on LDL-C in female college students
Рис. 4. Лесной график влияния ВИИТ на ХС ЛПНП у студенток

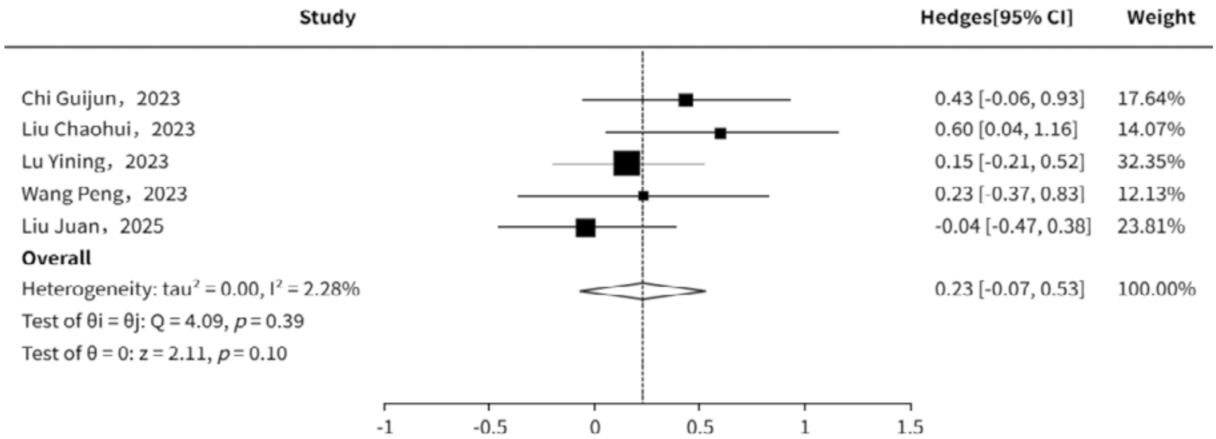

Fig. 5. Forest plot of the effect of HIIT on HDL-C in female college students
Рис. 5. Лесной график влияния ВИИТ на уровень ХС ЛПВП у студенток

Table 3

Publication bias test for included studies

Таблица 3

Тест на публикационную смещенность для включенных исследований

Variable	Regression-based Egger's test				
	beta1	**df**	**Standard error**	***t***	***p***
TC	0.790	4	2.519	0.314	0.769
TG	-0.284	5	2.361	-0.120	0.909
LDL-C	-1.886	5	1.684	-1.120	0.314
HDL-C	2.950	3	2.288	1.289	0.288
Variable	Non-parametric rank correlation (Begg) test				
	Kendall's score		Standard error	z	p
TC	3.000		5.323	0.564	0.573
TG	1.000		6.658	0.150	0.881
LDL-C	1.000		6.658	0.150	0.881
HDL-C	4.000		4.082	0.980	0.327

bias, this study adopted Egger's linear regression method and Begg's non-parametric rank correlation method. As shown in Table 3, no significant bias was found in the included study indicators ($p > 0.05$).

4. Discussion

As a non-pharmacological treatment method, exercise prescription has gained recognition in various aspects for the treatment and prevention of blood lipid health issues [21]. Although traditional MICT has been proven to have certain effects in studies on blood lipid reduction, for college students with heavy academic workloads, MICT usually requires a duration of more than 30 minutes, and its single movement pattern and training method often lead to a strong sense of psychological burnout [22, 23]. HIIT, as a new type of training mode, has currently been widely recognized in the fields of sports medicine and fitness. The derivative aerobics designed based on its principles can not only shorten the training duration but also play a positive role in improving body fat and blood lipid indicators; for female college students, such aerobics can also enhance training interest. If integrated into college physical education courses, it can not only enrich the course content but also help improve their long-term training compliance [24].

HIIT uses an alternating pattern of "high-intensity exercise + rest intervals", which is more effective in mobilising the energy metabolism system [25]. Its high-intensity phase prompts the body to rapidly deplete muscle glycogen reserves, forcing adipose tissue to break down faster to maintain energy supply [26]. HIIT regulates TC levels in two ways. The explosive exercise phase relies mainly on adrenergic activation to accelerate cholesterol turnover, whereas conventional aerobic training remodels hepatic cholesterol metabolism pathways through metabolic adaptive mechanisms, and this intensity-dependent modulatory property results in a progressive optimisation of TC regulation [27].

In terms of TG metabolism, the unique post-exercise excess oxygen consumption (EPOC) effect of HIIT produces a sustained state of metabolic activation [28]. This bodily response not only prolongs the time window for fat burning, but also accelerates the metabolic clearance of TG after meals and, more importantly, enhances skeletal muscle mitochondrial β-oxidation, thereby building a more efficient fat metabolism [29].

Based on the above findings, it is recommended that HIIT be promoted as an exercise intervention for improving lipid metabolism in female university students, especially for those who need to rapidly reduce cardiovascular disease risk factors. In the future, we can further explore the personalised adaptation strategies of HIIT for people with different physical characteristics, exercise habits and metabolic bases, in order to improve the practical application of exercise intervention in the prevention and control of dyslipidaemia.

5. Conclusion

Compared with MICT, intervention through HIIT training in female college students can effectively improve blood lipid-related indicators such as TC, TG, LDL-C, and HDL-C. This finding can provide theoretical and practical basis for exercise intervention in the physical and mental health development of female college students. However, the study also has some limitations. Due to the constraints of the number of included studies and the complexity of HIIT exercise protocols, the above conclusions still need to be verified by more high-quality RCT to ensure the reliability and applicability of the findings.

Authors' contribution:

Yu Jun — conceptualization, methodology, investigation, writing and revision of the text, collection and analysis of literature, and communication with editors to prepare for publication.

Wang Huan — conceptualization, methodology, literature collection, text editing.

Yu Haotong — conceptualization, methodology, literature collection, and communication with editors to prepare for publication.

Вклад авторов:

Юй Цзюнь — концептуализация, методология, проведение исследования, написание и редактирование текста, сбор и анализ литературных источников, а также общение с редакторами для подготовки к публикации.

Ван Хуань — концептуализация, методология, сбор литературных источников, редактирование текста.

Юй Хаотун — концептуализация, методология, сбор литературных источников, редактирование текста, общение с редакторами для подготовки к публикации.

References / Литература

1. **Zhu Z., Wu F., Lu Y., Wang Z., Zang J., Yu H., et al.** The Association of Dietary Cholesterol and Fatty Acids with Dyslipidemia in Chinese Metropolitan Men and Women. Nutrients. 2018;10(08):961. https://doi.org/10.3390/nu10080961

2. **Deng X., Zhang M., Zhang X., Huang Z., Zhao Z., Li C., Mudoti N.G., Wang L., Wu J.** The Status of Blood Lipids Among Children and Adolescents — China, 2016–2017. China CDC Weekly. 2023;5(2):31–34. https://doi.org/10.46234/ccdcw2023.006

3. **Jia Na, Huang Cheng, Xia Chenxi.** The effect of exercise training on lipid profile. Chinese Circulation Journal, 2023;38(1):96–100. (In Chinese). https://doi.org/10.3969/j.issn.1000-3614.2023.01.012

4. **Alfhili M.A., Alsughayyir J., Basudan A.M., Ghneim H.K., Alfaifi M., Alamri H.S., Awan Z.A., Algethami M.R.** Patterns of Dyslipidemia in the Anemic and Nonanemic Hypertensive Saudi Population: A Cross-Sectional Study. Int. J. Gen. Med. 2022;15:7895–7906. https://doi.org/10.2147/IJGM.S379597

5. **du Souich P., Roederer G., Dufour R.** Myotoxicity of statins: Mechanism of action. Pharmac. Ther. 2017;175:1–16. https://doi.org/10.1016/j.pharmthera.2017.02.029

6. **Björnsson E.S.** Hepatotoxicity of statins and other lipid-lowering agents. Liver International, 2017;37(02):173–178. https://doi.org/10.1111/liv.13308

7. **Armitage J., Bowman L., Wallendszus K., Bulbulia R., Rahimi K., Haynes R., et al.** Intensive lowering of LDL cholesterol with 80 mg versus 20 mg simvastatin daily in 12 064 survivors of myocardial infarction: a double-blind randomised trial. Lancet. 2010;376(9753):1658. https://doi.org/10.1016/S0140-6736(10)60310-8

8. **Suder A., Makiel K., Targosz A., Maciejczyk M., Kosowski P., Haim A.** Exercise-induced effects on asprosin and indices of atherogenicity and insulin resistance in males with metabolic syndrome: a randomized controlled trial. Sci. Rep. 2024;14(1):985. https://doi.org/10.1038/s41598-024-51473-1

9. **Ben-Zeev T., Okun E.** High-Intensity Functional Training: Molecular Mechanisms and Benefits. Neuromolecular Med. 2021;23(3):335–338. https://doi.org/10.1007/s12017-020-08638-8

10. **Wisloff Ulrik, Ellingsen Oyvind, Kemi Ole J.** High-Intensity Interval Training to Maximize Cardiac Benefits of Exercise Training? Exerc. Sport Sci. Rev. 2009;37(03):139–146. https://doi.org/10.1097/JES.0b013e3181aa65fc

11. **Atakan M.M., Li Y., Koşar Ş.N., Turnagöl H.H., Yan X.** Evidence-Based Effects of High-Intensity Interval Training on Exercise Capacity and Health: A Review with Historical Perspective. Int. J. Environ. Res Public Health. 2021;18(13):7201. https://doi.org/10.3390/ijerph18137201

12. **Hargreaves M., Spriet L.L.** Skeletal Muscle Energy Metabolism During Exercise. Nat. Metab. 2020;2(9):990. https://doi.org/10.1038/s42255-020-00290-7

13. **Gibala M.J., Jones A.M.** Physiological and performance adaptations to high-intensity interval training. Nestle Nutr. Inst. Workshop Ser. 2013;76:51–60. https://doi.org/10.1159/000350256

14. **Lin Jian, Zhao Hongqin, Huang Xiongang, Liu Xiaolin, Zhang Rui.** Seffect of High Intensity Interval Training on the Body Composition. Blood Lipid and Fasting Insulin Level of Obese Female College Students. Chinese General Practice. 2016;19(18):2139–2144. (In Chinese). https://doi.org/10.3969/j.issn.1007-9572.2016.18.006

15. **Chi Guijun, Liu Yuanyuan, Han Dong, Liang Yiwei, Sun Jianli.** A Study on the interaction Effect of High Intensity Cycle Training (HICT) on Obese Female College Students in Normal Universities. Journal of Tangshan Normal University. 2023;45(3):79–83. Available at: https://cstj.cqvip.com/Qikan/Article/Detail?id=7110131307. (In Chinese).

16. **Liu Chaohui, Pang Yajun, Meng Huili, Jiao Jie.** Effect of sedentary interval intervention on body composition and blood lipid metabolism of obese female college student. Chinese Journal of School Health. 2023,44(8):1140–1144. (In Chinese). https://doi.org/10.16835/j.cnki.1000-9817.2023.08.005

17. **Cai Xiaolin.** Impacts of High-Intensity Interval Training on Body Composition of Female University Students. Revista Brasileira de Medicina do Esporte. 2023;29:e2023_0053. https://doi.org/10.1590/1517-8692202329012023_0053

18. **Lu Y., Wiltshire H.D., Baker J.S., Wang Q., Ying S.** The Effect of Tabata-Style Functional High-Intensity Interval Training on Cardiometabolic Health and Physical Activity in Female University Students. Front. Physiol. 2023;14:1095315. https://doi.org/10.3389/fphys.2023.1095315

19. **Wang Peng, Liu Baoliang, Liu Yan, Jiang Di.** Effects of different intensity of exercise combined with dietary intervention on body composition, lipid metabolism and gut microbiota in obese nonalcoholic fatty liver disease female college students oholic fatty liver disease female college students. Chinese Journal of School Health. 2023;44(8):1169–1173. Available at: https://med.wanfangdata.com.cn/Paper/Detail?id=PeriodicalPaper_zgxxws202308013&dbid=WF_QK. (In Chinese).

20. **Liu Juan, Lu Wenjuan, Liu Fuding.** Effects of a Low-Calorie Diet Combined With High-Intensity Interval Training on Body Composition, Glycolipid Metabolism and Cardiopulmonary Function in Female Overweight College Students. Practical Preventive Medicine. 2025;32(4):448–452. https://doi.org/10.3969/j.issn.1006-3110.2025.04.014

21. **O'Donovan G., Blazevich A.J., Boreham C., Cooper A.R., Crank H., Ekelund U., et al.** The ABC of physical activity for health: a consensus statement from the British Association of Sport and Exercise Sciences. J. Sports Sci. 2010;28(6):573–591. https://doi.org/10.1080/02640411003671212

22. **Dubonosova S.V.** Reasons for sports discontinuation: a retrospective analysis of the physical activity in medical

students. Sports medicine: research and practice. 2023;13(1):21–27. (In Russ.). https://doi.org/10.47529/2223-2524.2023.1.3

23. **Wu C.H., Zhao Y.D., Yin F.Q., Yi Y., Geng L., Xu X.** Mental Fatigue and Sports Performance of Athletes: Theoretical Explanation, Influencing Factors, and Intervention Methods. Behav. Sci. (Basel). 2024;14(12):1125. https://doi.org/10.3390/bs14121125

24. **Plizga J., Jaworski A., Grajnert F., Gluszczyk A., Surma A., Cecot J., et al.** High-Intensity Interval Training - health benefits and risks - literature review. Quality in Sport. 2024;18:53359. https://doi.org/10.12775/QS.2024.18.53359

25. **Poon E.T., Siu P.M., Wongpipit W., Gibala M., Wong S.H., et al.** Alternating high-intensity interval training and continuous training is efficacious in improving cardiometabolic health in obese middle-aged men. J. Exerc. Sci. Fit. 2022;20(1):40–47. https://doi.org/10.1016/j.jesf.2021.11.003

26. **Tormaa F., Gombosa Z., Jokaia M., Takeda M., Mimura T., Radak Z.** High intensity interval training and molecular adaptive response of skeletal muscle. Sports Med. Health Sci. 2019;1(1):24–32. https://doi.org/10.1016/j.smhs.2019.08.003

27. **Boutcher S.H.** High-Intensity Intermittent Exercise and Fat Loss. J. Obes. 2011;868305. https://doi.org/10.1155/2011/868305

28. **Talanian J.L., Galloway S.D., Heigenhauser G.J., Bonen A., Spriet L.L.** Two weeks of high-intensity aerobic interval training increases the capacity for fat oxidation during exercise in women. J. Appl. Physiol. 2007;102(4):1439–1447. https://doi.org/10.1152/japplphysiol.01098.2006

29. **Li Yu, Chang Mengmeng, Liu Yang.** Re-recognition of fat burning in exercise: research progress on fat-reducing mechanism of HIIT. Chinese Bulletin of Life Sciences. 2023;35(9):1120–1127. (In Chinese). https://doi.org/10.13376/j.cbls/2023123

Information about the authors:

Yu Jun, PhD student, Department of Basketball Theory and Methodology, The Russian University of Sports "GTSOLIFK", Russia, Moscow, 105122, Lilac Boulevard 4k1. ORCID: https://orcid.org/0009-0004-1232-6363 (1041060816@qq.com)

Wang Huan, PhD student, departments of Speed skating, figure skating, and curling Theory and Methodology, The Russian University of Sports "GTSOLIFK", Russia, Moscow, 105122, Lilac Boulevard 4k1; Jilin sports university, China, 130022, Changchun, 2476 Nanling Street, Huayang Neighborhood, Ziyu Street. ORCID: https://orcid.org/0009-0001-6509-6790 (wsnghuan705@mail.ru)

Yu Haotong*, PhD student, Department of Psychology, Philosophy and Sociology, The Russian University of Sports "GTSOLIFK", Russia, Moscow, 105122, Lilac Boulevard 4k1. ORCID: https://orcid.org/0009-0001-9860-1810 (yu_haotong@mail.ru)

Информация об авторах:

Юй Цзюнь, аспирант кафедры теория и методики баскетбола, Российский университет спорта, «ГЦОЛИФК», Россия, 105122, Москва, Сиреневый бульвар, дом 4к1. ORCID: https://orcid.org/0009-0004-1232-6363 (1041060816@qq.com)

Ван Хуань, аспирант кафедры теории и методики конькобежного спорта, фигурного катания на коньках и кёрлинга, Российский университет спорта «ГЦОЛИФК», Россия, 105122, Москва, Сиреневый бульвар, дом 4к1; Цзилиньский спортивный университет, Китай, 130022, Чанчунь, улица Наньлин, микрорайон Хуаян, улица Цзыю, дом 2476. ORCID: https://orcid.org/0009-0001-6509-6790 (wsnghuan705@mail.ru)

Юй Хаотун*, аспирант кафедры психологии, философии и социологии, Российский университет спорта «ГЦОЛИФК», Россия, 105122, Москва, Сиреневый бульвар, дом 4к1. ORCID: https://orcid.org/0009-0001-9860-1810 (yu_haotong@mail.ru)

*** Corresponding author / Автор, ответственный за переписку**