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Combined therapy for intestinal dysbiosis as a strategy for the treatment of lipid metabolism disorders

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Abstract. Dyslipidaemia, a major contributor to cardiovascular diseases, necessitates multifaceted treatment strategies. This study aimed to evaluate the effectiveness of combined therapy – including probiotics, lifestyle modifications, and dietary recommendations – in managing dyslipidaemia and its impact on gut microbiota composition. A total of 168 patients with dyslipidaemia were enrolled and categorised according to cardiovascular risk using the SCORE scale. Group 1 included low-risk patients, while Group 2 comprised moderate-risk patients who also received simvastatin. Both groups were prescribed a 12-week probiotic regimen containing *Lactobacillus acidophilus* LA-5 and *Bifidobacterium lactis* BB-12, alongside recommendations for physical activity and cholesterollowering diets. Comprehensive assessments of lipid profiles and gut microbiota composition were conducted before and after treatment. The results demonstrated significant improvements in lipid profiles in both groups. Total cholesterol, low-density lipoprotein cholesterol, and triglyceride levels decreased, while high-density lipoprotein cholesterol levels increased. Statistical analysis showed that the differences in the percentage reductions of lipid profile parameters between the two groups were not statistically significant ($p > 0.05$), confirming the potential impact of probiotic therapy on lipid levels. Analysis of the gut microbiota revealed an increase in Bacteroidetes, and reductions in Firmicutes and Actinobacteria, along with a notable improvement in the Firmicutes/Bacteroidetes ratio, indicating restored microbial balance. This study highlighted the potential of probiotics as an effective adjunct in the management of dyslipidaemia, capable of complementing – or even reducing dependence on – statin therapy. The findings support the integration of microbiota-targeted therapies into personalised treatment strategies for dyslipidaemia

Keywords: microbial composition; dyslipidaemia; probiotics; *Bifidobacterium lactis* BB-12; *Lactobacillus acidophilus* LA-5

Introduction

The rising prevalence of metabolic disorders – particularly dyslipidaemia – poses a significant public health challenge worldwide. Alterations in the gut microbiota have emerged as a critical factor influencing lipid metabolism. An imbalanced intestinal microbial community may trigger inflammatory processes and disrupt the regulation of cholesterol and triglycerides, thereby increasing the risk of cardiovascular diseases. In this context, exploring novel therapeutic approaches – including probiotic interventions to restore microbial equilibrium and improve lipid profiles – has become increasingly important. Addressing these issues is essential not only for advancing scientific understanding but also for developing effective strategies to reduce the burden of metabolic diseases.

Data from the study by E. Pavlidou *et al.* [1] demonstrated that gut microbiota composition plays a crucial role in cardiovascular health, particularly through its influence on lipid metabolism and inflammatory responses. The review of clinical evidence indicated that specific probiotic and prebiotic interventions may reduce serum cholesterol

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levels, lower blood pressure, and exert antiinflammatory effects. These results support the potential of microbiota-targeted therapies as a promising strategy for the prevention and management of cardiovascular disease. This is also consistent with the findings of the review conducted by A. Oniszczuk *et al.* [2], who emphasised that modulation of the gut microbiota through the use of probiotics and prebiotics may support cardiovascular health by regulating blood lipids, reducing inflammation, and improving endothelial function.

Findings from the research conducted by K. Banach *et al.* [3] demonstrated that the consumption of probiotic yoghurt enriched with *Lactobacillus acidophilus* LA-5 and *Bifidobacterium lactis* BB-12 could improve lipid profiles in obese individuals. In their randomised controlled trial, the authors reported significant reductions in total cholesterol and improvements in the LDL/HDL ratio when the probiotic product was administered under an energy-restricted diet. Their detailed evaluation highlighted that both the dosage and duration of probiotic administration were critical factors influencing the observed metabolic benefits.

Results from the investigation by P. Markowiak-Kopeć & K. Śliżewska [4] revealed that probiotics play a crucial role in enhancing the production of short-chain fatty acids (SCFAs). The study's data showed that increased SCFA production was closely associated with reduced inflammatory responses and improved regulation of lipid metabolism. According to the authors, this mechanism may represent a key pathway through which probiotics alleviate dyslipidaemia, thereby providing a foundation for the development of probiotic-based metabolic therapies.

In the study by S.A. Palaniyandi *et al.* [5], the authors reported that specific cholesterollowering *Lactobacillus fermentum* strains exhibit promising probiotic characteristics *in vitro*. Their research provided evidence that these probiotics can directly influence cholesterol metabolism, suggesting a potential role for such microorganisms in reducing cholesterol levels *in vivo*. Data from A. Khare & S. Gaur [6] further underscored the cholesterol-lowering effects of various *Lactobacillus* species, demonstrating that these bacteria can contribute to improved lipid profiles by modulating bile acid metabolism and enhancing lipid excretion. Their comprehensive analysis highlighted the potential of probiotic interventions to restore metabolic homeostasis [7].

Evidence obtained by S. Wongrattanapipat *et al.* [8] highlighted the complexity of probiotic effects on metabolism by selecting potential probiotics with cholesterol-lowering properties for yoghurt production. Their *in vitro* assays identified strains capable of significantly reducing cholesterol levels, thereby supporting the concept that probiotic supplementation can be an effective tool in managing dyslipidaemia. Despite some promising results, certain findings remain contested. For instance, in a double-blind, randomised, placebo-controlled clinical trial, M. Noori *et al.* [9] demonstrated that although probiotic-enriched kefir containing *Lactobacillus helveticus* and *Bifidobacterium longum* did not significantly alter lipid profiles in elderly individuals over an eightweek period, it resulted in notable improvements in the atherogenic plasma index and Castelli's risk index.

Thus, more detailed studies are needed to determine the most effective strategies for incorporating these probiotic strains into treatments aimed at improving lipid metabolism. This study aimed to investigate the potential impact of specific probiotic strains on lipid metabolism in patients with dyslipidaemia.

Materials and Methods

The study included 168 patients diagnosed with dyslipidaemia types IIa, IIb, and IV according to the Fredrickson classification, who were either hospitalised or treated on an outpatient basis. This study did not account for the specific types of dyslipidaemia when assessing treatment outcomes but instead focused on the overall dynamics of lipid profile reduction across the combined patient group. All patients received care in the therapeutic department of Saint Pantaleon Hospital under the First Territorial Medical Association of Lviv, the therapeutic department of Agency Truskavetskurort LLC, or outpatient clinics No. 1 and No. 2 of the Intersono private medical centre, which also serve as clinical bases for the Department of Therapy No. 1, Medical Diagnostics, Hematology, and Transfusiology at Danylo Halytsky Lviv National Medical University. The study Group comprised 75 men and 93 women, aged 21 to 69 years, with a mean age of 45.03 ± 2.67 years.

All participants were informed about the protection of their anonymity, and the intended use of their data, and provided informed consent for its use in scientific research. This information was presented in accordance with current ethical standards and regulations governing medical research involving human subjects. The study was conducted in accordance with the main provisions of the Declaration of Helsinki of the World Medical Association on Ethical Principles for Medical Research Involving Human Subjects [10], the Council of Europe's Convention on Human Rights and Biomedicine [11], and Order No. 690 of the Ministry of Health of Ukraine [12]. The inclusion criteria for participation were: a confirmed diagnosis of dyslipidaemia based on clinical, laboratory, and instrumental methods; and the patient's signed informed consent to participate in the study.

Patient assessments were conducted using a range of methods. General clinical methods included the evaluation of medical history, collection of anamnesis, and general physical examination, including the measurement of anthropometric parameters. Biochemical methods were used to assess total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein cholesterol (VLDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) levels before and after the prescribed therapy. These analyses were performed using enzymatic colourimetric methods with reagent kits supplied by Human GmbH (Germany), on a BioChem

FC-360 analyser (High Technology Inc., USA). Instrumental methods included ultrasound examination of the abdominal organs and the head and neck vessels, performed using the LOGIQ P10 XDclear device. Bacteriological methods involved quantitative real-time polymerase chain reaction (qRT-PCR) analysis of the intestinal microbiota using primers targeting the 16S rRNA gene, specific for Firmicutes, Actinobacteria, and Bacteroidetes, as well as universal primers. The procedure was carried out using a Rotor-Gene 6000 (QIAGEN, Germany). Given the current absence (as of 20232024) of universally established normal ranges for bacterial phyla – due to variability influenced by the region of residence, dietary patterns, and individual habits – this study included 45 practically healthy volunteers aged 18 to 59 years, to assess the typical microbiota composition in the region of study (Lviv) (Table 1).

Table 1. Microbiota composition in healthy volunteers (n = 45)

	M ± m
Bacteroidetes, %	43.8 ± 1.4
Firmicutes, %	35.26 ± 0.89
Actinobacteria, %	7.38 ± 0.41
Others, %	14.22 ± 0.11
Firmicutes/Bacteroidetes ratio	3.55 ± 0.4

Source: compiled by the author

A total of 168 patients with dyslipidaemia were divided into two subgroups based on individual cardiovascular risk, calculated using the SCORE scale [13] to estimate the 10-year risk of fatal cardiovascular events and stratified according to LDL cholesterol levels as follows: <2.6 mmol/L, 2.6 to <3.0 mmol/L, and ≥3.0 mmol/L. The classification was performed in accordance with the guidelines of the European Society of Cardiology and the European Atherosclerosis Society [14], as well as the Recommendations for the Diagnosis and Treatment of Dyslipidaemia issued by the Ukrainian Association of Cardiologists [15]. In Group 1, LDL cholesterol levels were up to 3.0 mmol/L, and patients were categorised as having low or moderate risk according to the SCORE scale. No atherosclerotic changes were detected in the carotid arteries based on ultrasound findings. Group 2 comprised patients with LDL cholesterol levels exceeding 3.0 mmol/L, moderate SCORE-based cardiovascular risk, and/or atherosclerotic changes observed on carotid ultrasound. These patients were prescribed simvastatin at a dose of 10 mg once daily (in the evening), as recommended by a cardiologist. The study design did not include a comparison Group receiving statin therapy without concomitant probiotic supplementation.

Both groups received lifestyle modification recommendations, including engaging in 150 minutes of moderate-intensity physical activity per week, spread over 3 to 5 sessions, incorporating both aerobic and strength training. In addition, dietary guidance aimed at lowering cholesterol levels was provided. Therapy for correcting gut microbiota was prescribed in both groups. This included administration of a probiotic containing *Lactobacillus acidophilus* LA-5 and *Bifidobacterium lactis* BB-12 at a total concentration of 2×10^9 CFU, with 1×10^9 CFU per capsule, at a dosage of two capsules per day, for 12 weeks. Patients who failed to adhere to the prescribed medication regimen or who were unable to continue treatment due to unforeseen circumstances or newly developed comorbidities were excluded from the study. As a result, the final number of patients who completed the course of treatment was 112: Group 1 (n = 65) – patients with dyslipidaemia classified as lowrisk according to the SCORE scale; Group 2 (n = 47) – patients with dyslipidaemia classified as moderaterisk according to the SCORE scale. Data were analysed using Statistica 11.0 for Windows. Results are presented as mean ± standard error (M ± m). Student's t-test was used for comparing means, with significance defined as $p < 0.05$. Non-parametric methods were employed for variables that did not follow a normal distribution. Correlation analysis was conducted to explore relationships among parameters.

Results

Firstly, the composition of the gut microbiota was assessed in patients with dyslipidaemia and a control Group comprising individuals without lipid metabolism disorders (Table 2).

Table 2. Gut microbiota composition in patients with dyslipidaemia (n = 168) and the control Group (n = 86)

	Dyslipidaemia group (n = 168)	Control group (n = 86)	p-value
Bacteroidetes	35.17 ± 1.36	45.66 ± 1.18	<0.05
Firmicutes	45.26 ± 2.34	33.93 ± 1.63	<0.05
Actinobacteria	12.37 ± 0.39	8.9 ± 1.5	<0.05
Firmicutes/ Bacteroidetes ratio	3.52 ± 0.4	4.57 ± 1.48	>0.05

Note: $p < 0.05$ – statistically significant
Source: compiled by the author

Based on the obtained data, a significant difference was observed in the levels of nearly all phylotypes identified in the microbiota of patients with dyslipidaemia compared to those without. However, an important observation was that the indicators among individuals without dyslipidaemia showed minimal variation from those of healthy volunteers, who served as the control sample. The gut microbiota composition was also analysed in both patient groups, categorised according to their SCORE risk levels, who were subsequently prescribed probiotic therapy (Table 3).

Table 3. Gut microbiota composition in patients with dyslipidaemia, grouped by SCORE risk classification

	Group 1 (n = 65)	Group 2 (n = 47)
Bacteroidetes	38.5 ± 0.78	35.01 ± 1.19
Firmicutes	42.14 ± 1.67	46.05 ± 0.89
Actinobacteria	10.76 ± 1.49	12.95 ± 0.81
Firmicutes/ Bacteroidetes ratio	3.8 ± 0.51	2.9 ± 1.65

Source: compiled by the authors

After 12 weeks of treatment with the probiotics *Lactobacillus acidophilus* LA-5 and *Bifidobacterium lactis* BB-12, the gut microbiota composition was re-assessed in both groups of patients (Figs. 1, 2).

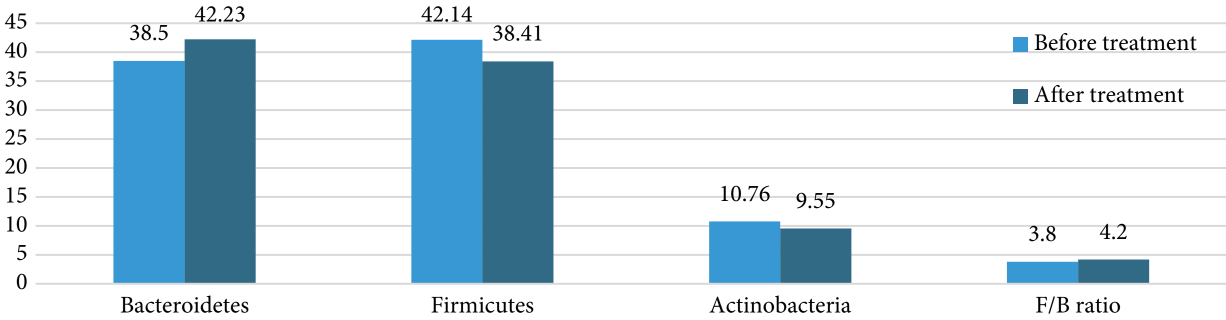

Figure 1. Gut microbiota composition in Group 1 patients with dyslipidaemia before and after combined therapy
Source: compiled by the author

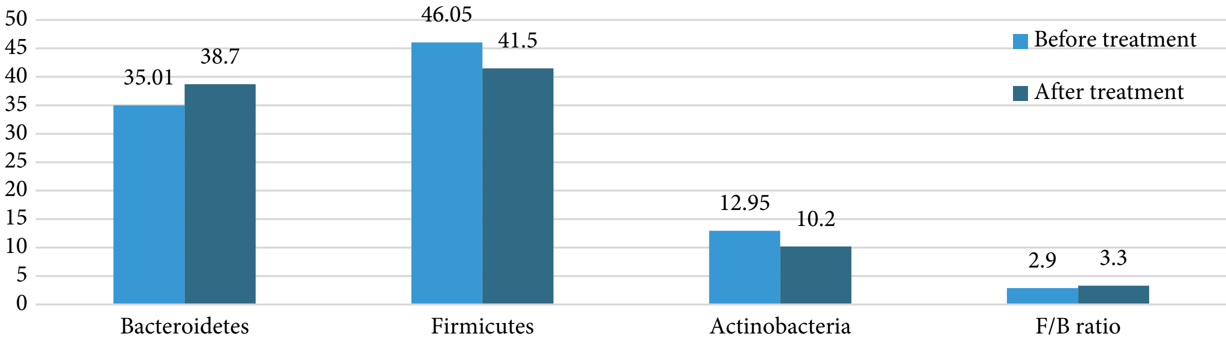

Figure 2. Gut microbiota composition in Group 2 patients with dyslipidaemia before and after combined therapy
Source: compiled by the author

As shown in Figure 1, patients in Group 1 demonstrated an increase in Bacteroidetes levels, a decrease in Firmicutes and Actinobacteria, and a shift in the Firmicutes/Bacteroidetes ratio during probiotic administration. In Group 2, an increase in Bacteroidetes was also observed, accompanied by a marked decrease in Firmicutes and Actinobacteria, as well as corresponding changes in the Firmicutes/Bacteroidetes ratio (Fig. 2). Since the primary aim of the study was to explore the interrelationship and potential influence of gut microbiota modulation on the development of dyslipidaemia, it was essential to evaluate lipid profile parameters both before and after treatment (Tables 4, 5).

Table 4. Lipid profile parameters in Group 1 patients with dyslipidaemia before and after combined treatment

Group 1	Before treatment (n = 65)	After treatment (n = 65)	p-value
TC, mmol/L	6.4 ± 0.22	5.4 ± 0.28	<0.05
TG, mmol/L	1.6 ± 0.34	1.4 ± 0.12	>0.05
HDL-C, mmol/L	1.36 ± 0.04	1.72 ± 0.02	<0.05

Continued Table 4

Group 1	Before treatment (n = 65)	After treatment (n = 65)	p-value
LDL-C, mmol/L	3.88 ± 0.19	2.8 ± 0.23	<0.05
VLDL, mmol/L	0.9 ± 0.28	0.77 ± 0.07	>0.05

Note: $p < 0.05$ – statistically significant
Source: compiled by the author

Table 5. Lipid profile parameters in Group 2 patients with dyslipidaemia before and after combined treatment

Group 2	Before treatment (n = 47)	After treatment (n = 47)	p-value
TC, mmol/L	6.8 ± 0.35	5.2 ± 0.08	<0.05
TG, mmol/L	2.3 ± 0.36	1.6 ± 0.16	<0.05
HDL-C, mmol/L	1.25 ± 0.21	1.68 ± 0.56	>0.05
LDL-C, mmol/L	3.99 ± 0.18	3.1 ± 0.23	>0.05
VLDL, mmol/L	1.09 ± 0.16	1.01 ± 0.07	>0.05

Note: $p < 0.05$ – statistically significant
Source: compiled by the author

The assessment of probiotic therapy, combined with lifestyle modifications and dietary recommendations, significantly improved TC levels in Group 1 patients, from 6.4 ± 0.22 to 5.4 ± 0.28 mmol/L. A statistically significant reduction in LDL-C was also observed following treatment. Furthermore, HDL-C levels increased by 26%. According to Table 5, the mean total cholesterol level in Group 2 decreased significantly after combined therapy, from 6.8 ± 0.35 mmol/L to 5.2 ± 0.08 mmol/L ($p < 0.05$). The TG were also nearly halved, decreasing from 2.3 ± 0.36 mmol/L to 1.6 ± 0.16 mmol/L post-treatment. A statistically significant increase in HDL-C levels was recorded, rising from 1.25 ± 0.21 mmol/L to 1.68 ± 0.56 mmol/L ($p < 0.05$). In light of these findings, the percentage changes in lipid profile parameters across both groups were evaluated (Figs. 3, 4).

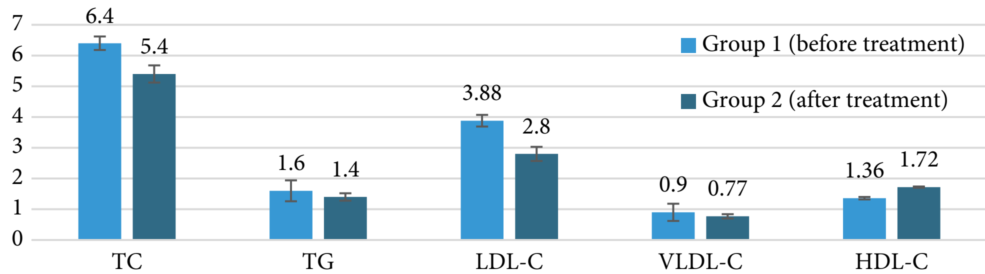

Figure 3. Lipid profile changes after combined therapy in Group 1 patients with dyslipidaemia
Source: compiled by the author

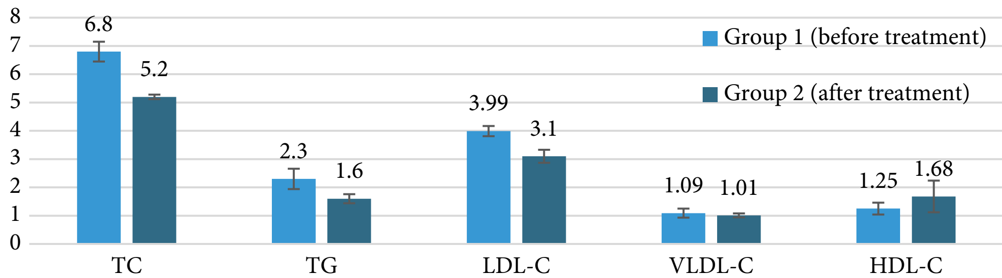

Figure 4. Lipid profile changes after combined therapy in Group 2 patients with dyslipidaemia
Source: compiled by the author

When comparing the lipid profile dynamics presented in Figures 3 and 4, statistical analysis revealed that, despite the addition of simvastatin to probiotic therapy in Group 2, the percentage changes in lipid parameters did not differ significantly between the two groups ($p > 0.05$). In Group 1, TC decreased by 15.6% (from 6.4 ± 0.22 to 5.4 ± 0.28 mmol/L, $p < 0.05$), and LDL-C decreased by 27.8% (from 3.88 ± 0.19 to 2.8 ± 0.23 mmol/L, $p < 0.05$). In Group 2, TC was reduced by 23.5% (from 6.8 ± 0.35 to 5.2 ± 0.08 mmol/L, $p < 0.05$), and LDL-C by 22.3% (from 3.99 ± 0.18 to 3.1 ± 0.23 mmol/L, $p > 0.05$). Although the absolute percentage reductions in TC and LDL-C appeared somewhat greater in Group 2, inter-Group comparisons did not yield statistically significant differences ($p > 0.05$ for both parameters). Additionally, HDL-C levels increased by 26.5% in Group 1 (from 1.36 ± 0.04 to 1.72 ± 0.02 mmol/L, $p < 0.05$) and by 34.4% in Group 2 (from 1.25 ± 0.21 to 1.68 ± 0.56 mmol/L, $p > 0.05$), with no significant difference observed between groups ($p > 0.05$).

Discussion

The results of this study provide strong evidence supporting the effectiveness of combined therapy – consisting of probiotic supplementation with *Lactobacillus acidophilus* LA-5 and *Bifidobacterium lactis* BB-12, alongside lifestyle modifications and dietary recommendations – in improving lipid metabolism in patients with dyslipidaemia. Notably, the administration of these probiotic strains resulted in significant improvements in TC, LDL-C, and TG levels, while also inducing a marked increase in HDL-C. Importantly, these benefits were observed in both low- and moderate-risk groups, as classified by the SCORE scale, indicating that probiotic therapy may exert a direct effect on lipid metabolism irrespective of concurrent pharmacological interventions.

S. Zhou *et al.* [16] provided compelling evidence linking gut microbial metabolism with variations in circulating non-HDL cholesterol levels, thereby reinforcing the concept that modifications in microbiota can lead to measurable improvements in lipid profiles. In a complementary approach, C. Yan *et al.* [17] investigated the interplay between gut microbiota, systemic inflammation, and LDL-C using multiomics techniques, suggesting that inflammatory mediators may partly account for the benefits observed with probiotic interventions. The underlying mechanisms indicate that improvements in lipid parameters may result from both direct microbial modulation and indirect anti-inflammatory effects.

B. Flaig *et al.* [18] reviewed the potential of targeted gut microbiota therapy as an innovative strategy for managing dyslipidaemia. Their conclusions align with the present findings, particularly the observation that percentage reductions in lipid parameters were comparable between patients receiving probiotics alone and those receiving a combination of probiotics and simvastatin. This suggests that, for certain patients, probiotics might complement – or even reduce the need for – conventional statin therapy.

Further supporting the link between gut microbial activity and cardiovascular risk, M. Canyelles *et al.* [19] examined the role of microbiota-derived metabolites, such as TMAO, in promoting atherosclerotic disease. Although the present study did not directly measure TMAO levels, the observed improvements in lipid profiles and favourable shifts in microbial composition may indirectly contribute to a reduced cardiovascular risk by altering the profile of microbial metabolites. E.M. Brown *et al.* [20] further reviewed how the gut microbiota influences lipid metabolism and host physiology, reinforcing the concept that microbiome-targeted interventions can yield systemic benefits extending beyond lipid regulation alone.

Regarding improvements in lipid profiles, the data showed that both study groups experienced reductions in TC, LDL-C, and TG, alongside an increase in HDL-C. Notably, although Group 2 received simvastatin in addition to probiotics, the percentage reductions in lipid parameters were similar to those in Group 1, which received probiotic therapy alone. This finding suggests that probiotics may exert a direct and robust effect on lipid metabolism, potentially reducing reliance on statins in selected patient populations. The substantial increase in HDL-C and reduction in LDL-C in both groups underscore the potential of these probiotic strains to enhance cardiovascular health – likely through mechanisms involving bile acid metabolism modulation, enhanced lipid excretion, and the attenuation of systemic inflammation.

It is worth noting that J. Roessler *et al.* [21] demonstrated that modulation of the gut microbiota significantly influences both cholesterol and glucose metabolism, with potential implications for the prevention and management of atherosclerotic cardiovascular disease. Their findings further support the concept that microbiome-targeted interventions – such as probiotic supplementation – can exert systemic metabolic benefits beyond lipid-lowering, thereby reinforcing the therapeutic potential of such strategies in patients with dyslipidaemia. Moreover, Y. Duan *et al.* [22] conducted a metaanalysis on the therapeutic effects of probiotic interventions in obese or overweight adolescents, demonstrating that probiotic supplementation can significantly improve metabolic parameters, including lipid profiles. Their findings suggest that modulating the gut microbiota plays a crucial role in enhancing cholesterol regulation, which aligns with the observation that probiotic therapy can favourably alter lipid metabolism.

In conclusion, the combination of probiotic therapy with lifestyle and dietary modifications presents a promising approach to the management of dyslipidaemia and associated cardiovascular risks. The findings of the present study, together with those of other researchers such as D.J. Kenny *et al.* [23], L. Lei *et al.* [24], and B.A. Kappel *et al.* [25] contribute to the growing body of evidence that targeting the gut microbiota can significantly impact lipid metabolism. This study also underscored the need for personalised treatment strategies that integrate both microbiometargeted therapies and traditional pharmacological interventions.

Conclusions

The results of this study demonstrated that combined therapy – including the use of *Lactobacillus acidophilus* LA-5 and *Bifidobacterium lactis* BB-12, alongside lifestyle modifications and dietary adjustments – is an effective strategy for managing dyslipidaemia. This approach significantly improved the lipid profile of patients by reducing TC, LDL-C, and TG levels while increasing HDLC. These changes were accompanied by measurable alterations in the gut microbiota, with a notable increase in Bacteroidetes and reductions in Firmicutes and Actinobacteria, suggesting a strong interrelationship between gut microbiota composition and the regulation of lipid metabolism.

A key finding was that the improvements in lipid profile in the Group receiving both probiotics and simvastatin were comparable to those observed in the Group receiving probiotics alone, highlighting the potential for probiotics to complement – or even reduce the need for – pharmacological interventions in selected cases. This underscored the value of incorporating gut microbiome-targeted therapies into comprehensive dyslipidaemia management strategies. The study also revealed that, in patients with dyslipidaemia, the Firmicutes/Bacteroidetes ratio significantly improved following treatment, indicating restored microbial balance as a potential mechanism contributing to lipid metabolism correction. These findings were particularly relevant in regions with distinctive dietary patterns and microbiota characteristics, where tailored interventions could optimise health outcomes.

Future research should focus on exploring the long-term effects of probiotic therapy on cardiovascular health, identifying the most effective strains and dosages, and investigating potential synergies between probiotics and pharmacological treatments. Expanding such studies to include larger and more diverse populations will help to refine the therapeutic potential of gut microbiota modulation in dyslipidaemia. In conclusion, this study confirms the effectiveness of combined therapy in improving both lipid profiles and gut microbiota health, supporting its role as a cornerstone in personalised dyslipidaemia management strategies.

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Conflict of Interest

None.

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Комбінована терапія лікування дисбіозу кишківника як один зі шляхів корекції порушень ліпідного обміну

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Анотація. Дисліпідемія, яка є основним чинником розвитку серцево-судинних захворювань, вимагає багатокомпонентних підходів до лікування. Метою даного дослідження було оцінити ефективність комбінованої терапії, яка включає пробіотики, зміни способу життя та дієтичні рекомендації, у корекції дисліпідемії та її вплив на склад мікробіому кишківника. У дослідженні взяли участь 168 пацієнтів із дисліпідемією, яких розподілили на групи відповідно до рівня серцево-судинного ризику за шкалою SCORE. До першої групи увійшли пацієнти з низьким ризиком, тоді як друга група складалася з пацієнтів із помірним ризиком, які додатково отримували симвастатин. Обом групам було призначено 12-тижневий курс пробіотиків, що містив *Lactobacillus acidophilus* LA-5 та *Bifidobacterium lactis* BB-12, а також рекомендовано фізичну активність і дієту для зниження рівня холестерину. Перед і після лікування було проведено комплексну оцінку ліпідного профілю та складу мікробіому кишківника. Результати показали значне покращення ліпідного профілю в обох групах. Рівні загального холестерину, ліпопротеїнів низької щільності та тригліцеридів зменшилися, тоді як рівень ліпопротеїнів високої щільності зріс. Статистичний аналіз показав, що різниця у відсотковому зниженні параметрів ліпідограми між обома групами не була статистично значущою ($p > 0,05$), що підтверджує можливий вплив пробіотичної терапії на рівень показників ліпідограми. Аналіз мікробіому кишківника виявив збільшення рівня бактерій типу Bacteroidetes та зменшення рівня Firmicutes і Actinobacteria, а також суттєве покращення індексу Firmicutes/Bacteroidetes, що свідчить про відновлення мікробного балансу. Дане дослідження підтверджує ефективність пробіотиків як важливого додаткового методу лікування дисліпідемії, здатного доповнити або навіть зменшити необхідність у застосуванні статинів. Отримані результати підтримують інтеграцію терапій, спрямованих на мікробіом, у персоналізовані стратегії лікування дисліпідемії

Ключові слова: мікробіом; дисліпідемія; пробіотики; *Bifidobacterium lactis* BB-12; *Lactobacillus acidophilus* LA-5