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## Dynamics of Lipid Metabolism Parameters in Oral Fluid and Blood in Elderly Patients during the Use of a Therapeutic and Preventive Complex

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### Abstract

*The oral health of elderly patients is closely related to systemic metabolic processes. Disorders of lipid metabolism are common in older adults and may influence inflammatory processes in periodontal tissues and the general condition of the oral cavity. Objective of this study was to evaluate the influence of a therapeutic and preventive complex on lipid metabolism indicators in oral fluid and blood serum in elderly patients during treatment. The study involved 34 elderly patients aged 60–75 years. The patients were divided into two groups: the main group (19 patients) and the comparison group (15 patients). Patients in the comparison group received only basic dental therapy, while patients in the main group additionally received a therapeutic and preventive complex including systemic and local agents. Lipid metabolism indicators in oral fluid (triglycerides and total cholesterol) and blood serum (total cholesterol, HDL, LDL, VLDL and atherogenic index) were evaluated at baseline and during follow-up after 3 months, 6 months, 1 year and 2 years. In elderly patients, lipid metabolism disorders were detected both in blood serum and oral fluid. The use of the therapeutic and preventive complex contributed to a significant decrease in triglycerides and total cholesterol in oral fluid as well as improvement of the lipid profile of blood serum, including a decrease in total cholesterol, LDL and VLDL levels and an increase in HDL levels with a reduction in the atherogenic index. The obtained results indicate the effectiveness of the therapeutic and preventive complex for maintaining oral health and preventing the progression of dental pathology in elderly patients considering systemic metabolic changes typical for this age group.*

**Keywords:** elderly patients; periodontal disease; oral fluid; lipid metabolism; therapeutic and preventive complex; oral-systemic health

### INTRODUCTION

The condition of oral tissues is closely related to the overall metabolic status of the organism. In elderly patients, age-related metabolic changes, vascular disorders, and the development of chronic systemic diseases are often accompanied by disturbances in lipid metabolism. Impaired lipid homeostasis, manifested by elevated levels of total cholesterol, triglycerides, and atherogenic lipoprotein fractions, is considered an important factor contributing to systemic inflammation and the development of atherosclerotic changes and may also influence the course of dental diseases (Skybchyk et al., 2021; LeNoir et al., 2025).

Recent studies have demonstrated a close relationship between lipid metabolism disorders and periodontal diseases. Elevated levels of triglycerides, total cholesterol, and low-

density lipoproteins have been associated with an increased risk of development and progression of generalized periodontitis, whereas decreased levels of high-density lipoproteins are accompanied by an enhanced inflammatory response in periodontal tissues (Mirzaei et al., 2022; Zhao et al., 2025).

It is believed that lipid metabolism disorders may exacerbate systemic inflammatory and immune responses that play an important role in the pathogenesis of periodontal diseases. Elevated levels of atherogenic lipoproteins can influence the metabolic activity of immune cells, promoting activation of pro-inflammatory signaling pathways and enhancing destructive processes in periodontal tissues (Zhao et al., 2025; Bonilla et al., 2025).

Considering the close relationship between systemic metabolic disturbances and the condition of oral tissues, the



search for comprehensive approaches to maintaining oral health in elderly patients is of particular importance. Such an approach involves the combination of basic dental therapy with systemic and local agents aimed at correcting metabolic, vascular, and inflammatory changes characteristic of older individuals. In this regard, the study of lipid metabolism parameters in oral fluid and blood serum of elderly patients during the use of therapeutic and preventive complexes aimed at maintaining oral health is of considerable scientific and clinical interest.

## AIM OF THE STUDY

To evaluate the effect of a therapeutic and preventive complex on lipid metabolism parameters in oral fluid and blood serum in elderly patients during treatment.

## MATERIALS AND METHODS

The study was conducted in accordance with the principles of bioethics and the Declaration of Helsinki of the World Medical Association. All participants were informed about the purpose and conditions of the study and provided written informed consent prior to participation.

### *Study population and inclusion criteria*

The study involved 34 elderly patients aged 60–75 years (according to WHO age classification). The mean age of the participants was  $66.2 \pm 9.2$  years. According to sex distribution, the study group consisted of 10 men (29.4%) and 24 women (70.6%).

Inclusion criteria were: age 60–75 years; presence of dental pathology, particularly generalized periodontitis stage I–II (grade A or B); presence of natural teeth allowing clinical dental examination; absence of contraindications to basic dental treatment and the use of the therapeutic and preventive complex; and voluntary informed consent to participate in the study.

Exclusion criteria included: acute inflammatory diseases of the oral cavity or exacerbation of chronic systemic diseases; severe decompensated somatic conditions; use of medications that could significantly influence lipid metabolism parameters; refusal to participate in the study or non-compliance with the recommended treatment regimen.

All included patients were diagnosed with generalized periodontitis stage I–II according to the classification of periodontal and peri-implant diseases and conditions (EFP & AAP World Workshop, 2017). Among them, 7 patients (20.6%) had grade B and 27 patients (79.4%) had grade A.

The mean DMFT index among all examined patients was  $16.65 \pm 3.06$ ; Me (Q1–Q3) = 16 (14–19); min–max = 11–24 (n = 34).

### *Study design*

Depending on the prescribed treatment, patients were divided into two groups: the main group (19 patients) and the comparison group (15 patients).

The comparison group included 5 men (33.3%) and 10 women (66.7%), whereas the main group consisted of 5 men (26.3%) and 14 women (73.7%).

Regarding periodontal status, the comparison group included 4 patients (26.7%) with grade B generalized periodontitis and 11 patients (73.3%) with grade A. In the main group, 3 patients (15.8%) had grade B and 16 patients (84.2%) had grade A.

The DMFT index in the main group was  $16.00 \pm 2.96$  (Me 15; Q1–Q3: 14–19; min–max: 11–21; n = 19), while in the comparison group it was  $17.47 \pm 3.10$  (Me 16; Q1–Q3: 15–19; min–max: 14–24; n = 15).

The obtained demographic and clinical characteristics indicated comparability of the groups in terms of age, sex distribution, periodontal status and dental indices, allowing them to be considered representative for comparative analysis.

### *Treatment protocol*

Patients in the comparison group received only basic dental therapy, including oral sanitation and professional oral hygiene.

Patients in the main group received the same basic therapy combined with a therapeutic and preventive complex after consultation with physicians specializing in internal medicine. The complex included systemic and local agents aimed at correcting metabolic, vascular, oxidative and microbiological disturbances in oral tissues typical for elderly individuals (Lipsky et al., 2024).

The systemic component included the probiotic preparation Opefera, L-glutamine, omega-3 polyunsaturated fatty acids (EPA + DHA), magnesium, coenzyme Q10 (ubiquinol), resveratrol and the multivitamin-mineral complex “Alphabet 50+”. The systemic agents were recommended twice a year for one month or according to the manufacturer's instructions.

The local component included agents for xerostomia management (Dentaid Xeros), antioxidant and reparative agents (VITIS Antiage, Quertgial), topical applications of mumiyo gel when indicated, chlorhexidine 0.05% antiseptic solution for 7–14 days after basic therapy, and fluoride-based remineralizing agents.

### *Biochemical analysis*

To evaluate the effect of the therapeutic and preventive complex on lipid metabolism, biochemical analysis of oral fluid and blood serum was performed at baseline and during follow-up after 3 months, 6 months, 1 year and 2 years.

Unstimulated oral fluid samples were collected in the morning on an empty stomach after rinsing the oral cavity with water and without prior oral hygiene. Samples were centrifuged at 2500 rpm for 20 minutes at +4 °C. The supernatant was used to determine triglyceride and total cholesterol concentrations.

Venous blood samples were obtained in the morning after 12–14 hours of fasting. Blood was collected using VACUETTE vacuum systems and centrifuged at 3000 rpm for 20 minutes to obtain serum.

Serum lipid parameters included total cholesterol, triglycerides, high-density lipoproteins (HDL), low-density lipoproteins (LDL), very-low-density lipoproteins (VLDL), and the atherogenic index calculated using the formula: AI = (Total cholesterol – HDL) / HDL. Biochemical parameters were determined using commercial diagnostic kits (Felicity-Diagnostics Ltd., Ukraine).

**Statistical analysis**

Statistical analysis was performed using standard methods of biomedical statistics. Quantitative variables were presented as mean (M) ± standard error (m), median (Me) and interquartile range (Q1–Q3). Differences between groups were assessed using parametric and non-parametric tests depending on data distribution. Changes during treatment were evaluated relative to baseline values and between groups. Differences were considered statistically significant at p < 0.05.

**Study limitations**

The limitations of this study include the relatively small sample size and the absence of detailed stratification according to concomitant systemic diseases that could influence lipid metabolism parameters. In addition, the study was conducted under clinical conditions without assessment of all behavioral and metabolic factors potentially affecting biochemical parameters of oral fluid and blood serum. Further studies with larger patient cohorts and consideration of metabolic status and comorbidities are required.

**RESULTS**

The results of biochemical analysis of oral fluid lipid metabolism parameters in patients of both groups are presented in Table 1.

**Table 1: Lipid metabolism parameters in oral fluid of elderly patients during treatment**

Parameters (mmol/L)	Groups	Time point				
		Baseline	After 3 months	After 6 months	After 1 year	After 2 years
Triglycerides	Comparison	0.19 ± 0.02	0.21 ± 0.02	0.16 ± 0.01	0.17 ± 0.02	0.20 ± 0.02
	Main	0.21 ± 0.02	0.15 ± 0.01*	0.13 ± 0.01*	0.10 ± 0.01*	0.12 ± 0.01*
Total cholesterol	Comparison	0.29 ± 0.02	0.27 ± 0.02	0.31 ± 0.02	0.28 ± 0.02	0.33 ± 0.03
	Main	0.26 ± 0.02	0.18 ± 0.02	0.20 ± 0.02	0.15 ± 0.02	0.17 ± 0.02

	in	0.02	0.02*	0.02*	0.01*	0.01*
			†	†	†	†

**Note:**

\* p < 0.05 vs baseline

† p < 0.05 vs comparison group

At baseline, elevated levels of triglycerides and total cholesterol were observed in the oral fluid of patients in both groups compared with reference values, indicating lipid metabolism disturbances typical for elderly individuals.

In the comparison group, where only basic dental therapy was performed, no statistically significant changes in triglyceride or total cholesterol concentrations in oral fluid were observed throughout the entire follow-up period (p > 0.05).

In contrast, patients in the main group who additionally received the therapeutic and preventive complex demonstrated a significant improvement in lipid metabolism indicators in oral fluid. A decrease in triglyceride levels was observed as early as 3 months after treatment, with a further reduction during the subsequent observation periods. This decrease remained statistically significant both compared with baseline values and relative to the comparison group.

A similar trend was observed for total cholesterol levels in oral fluid. In the comparison group, cholesterol concentrations remained elevated and did not differ significantly from baseline values during follow-up. However, in the main group a significant decrease in total cholesterol concentration was recorded beginning at 3 months after treatment, with sustained improvement during long-term observation.

The results of lipid spectrum analysis in blood serum are summarized in Table 2.

**Table 2: Lipid profile parameters in blood serum of elderly patients during follow-up**

Parameters (mmol/L)	Groups	Time point				
		Baseline	After 3 months	After 6 months	After 1 year	After 2 years
Total cholesterol	Comparison	7.67 ± 0.51	7.41 ± 0.44	7.53 ± 0.54	7.86 ± 0.32	7.42 ± 0.41
	Main	7.44 ± 0.42	6.15 ± 0.34*	5.44 ± 0.25*	5.73 ± 0.30*	4.98 ± 0.32*
HDL	Comparison	0.74 ± 0.05	0.80 ± 0.05	0.84 ± 0.07	0.87 ± 0.05	0.70 ± 0.04
	Main	0.74 ± 0.05	0.80 ± 0.05	0.84 ± 0.07	0.87 ± 0.05	0.70 ± 0.04

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	Main	0.69 ± 0.04	0.87 ± 0.03*	1.02 ± 0.14*	1.24 ± 0.10* †	1.15 ± 0.10* †
LDL	Comparison	5.16 ± 0.45	4.82 ± 0.21	4.96 ± 0.64	5.12 ± 0.34	5.24 ± 0.31
	Main	4.85 ± 0.32	4.12 ± 0.15* †	3.21 ± 0.43* †	2.97 ± 0.18* †	2.45 ± 0.19* †
VLDL	Comparison	1.02 ± 0.10	0.90 ± 0.06	0.87 ± 0.06	0.95 ± 0.04	0.83 ± 0.06
	Main	0.94 ± 0.08	0.82 ± 0.05	0.71 ± 0.04* †	0.66 ± 0.03* †	0.58 ± 0.03* †
Atherogenic index	Comparison	9.3 ± 0.6	8.2 ± 0.5	7.9 ± 0.5	8.0 ± 0.3	9.6 ± 0.6
	Main	9.7 ± 0.4	4.4 ± 0.3* †	4.3 ± 0.4* †	3.6 ± 0.1* †	3.3 ± 0.2* †

**Note:**

\*  $p < 0.05$  vs baseline

†  $p < 0.05$  vs comparison group

At baseline, elevated levels of total cholesterol and low-density lipoproteins were observed in patients of both groups, indicating disturbances in lipid metabolism and an increased risk of atherosclerotic changes in elderly individuals.

In the comparison group, where only basic dental treatment was provided, serum lipid parameters did not demonstrate significant changes during the observation period.

In contrast, patients in the main group receiving the therapeutic and preventive complex showed a progressive improvement in lipid profile parameters. A significant decrease in total cholesterol, LDL and VLDL was observed, accompanied by an increase in HDL.

In addition, a pronounced decrease in the atherogenic index was recorded in the main group during the follow-up period, reflecting a favorable shift in lipid metabolism and a reduction in cardiovascular risk factors.

Overall, the obtained results indicate that elderly patients exhibited disturbances in lipid metabolism reflected both in blood serum and oral fluid. The additional use of the therapeutic and preventive complex contributed to normalization of lipid metabolism parameters and

improvement of biochemical indicators associated with systemic metabolic status.

**DISCUSSION**

Disturbances in lipid metabolism, particularly elevated levels of atherogenic lipoprotein fractions, are considered one of the systemic factors contributing to chronic inflammation. Dyslipidemia may be accompanied by microcirculatory disorders, activation of pro-inflammatory mediators, and metabolic alterations in tissues, which can potentially influence the course of inflammatory periodontal diseases.

The obtained results demonstrate that lipid metabolism disturbances in elderly patients are reflected not only in blood serum parameters but also in the biochemical composition of oral fluid. The elevated concentrations of triglycerides and total cholesterol in oral fluid observed before treatment may be associated with systemic metabolic changes typical for older individuals. The normalization of these indicators in patients of the main group following the use of the therapeutic and preventive complex suggests a positive effect of a comprehensive approach combining basic dental therapy with systemic and local agents aimed at supporting metabolic balance and maintaining the functional condition of oral tissues.

The obtained data are consistent with modern concepts regarding the relationship between systemic metabolic disorders and oral health. The similar direction of changes in lipid metabolism parameters in oral fluid and blood serum confirms that oral fluid may reflect systemic metabolic processes in the body. This indicates the feasibility of using oral fluid as an accessible and non-invasive biological medium for assessing metabolic changes in elderly patients and monitoring the effectiveness of therapeutic and preventive measures, which corresponds to the modern concept of the relationship between systemic and oral health (oral-systemic health).

**CONCLUSIONS**

The obtained results indicate the feasibility of using the proposed therapeutic and preventive complex for maintaining oral health and preventing dental pathology in elderly patients, taking into account systemic metabolic changes characteristic of this age group.

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