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The relationship between blood serum lipids and periodontal condition

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SUMMARY

The aim of the study: the study analyzed he relationship between blood serum lipids and periodontal condition, as well as the relationship between the left ventricular mass index and the condition of periodontium. The study included 261 subjects – 140 women and 121 men. Mean age of the subjects was 38 years. The condition of periodontal tissues during the study was evaluated with the help of the CPITN index (Community Periodontal Index of Treatment Needs). The study was performed at Kaunas University of Medicine (KMU) Clinic of Dental and Oral Diseases. Laboratory blood lipid studies were performed at the laboratory of the Hospital of Kaunas University of Medicine (HKUM). The studies included the determination of the total blood cholesterol level, triglyceride level, HDL cholesterol level, and LDL cholesterol level (mmol/l). Patients with hypertension (102 patients) underwent ultrasound examination of the heart at KMU Clinic of Cardiology. On the basis of the findings of the ultrasound study, left ventricular mass index (g/m^2) was calculated.

The findings of our study showed that there was no difference in the blood serum concentration of total cholesterol, triglycerides, HDL cholesterol, and LDL cholesterol between people with healthy periodontium and those with gingivitis or periodontitis. Mean rank of the left ventricular mass index in subjects with healthy periodontium or gingivitis (CPITN codes 0, 1, 2) was 48.3, and in subjects with periodontitis (CPITN codes 3, 4) – 61.36 ($p<0.05$).

Key words: periodontal diseases, cardiovascular diseases, cholesterol, left ventricular mass.

INTRODUCTION

Although a number of studies have been performed recently on the possible association between cardiovascular diseases (CVDs) and periodontium, this association is not thoroughly understood yet [1,2,3,4].

CVDs are common all over the world, and atherosclerosis of coronary arteries is considered to be the leading cause of premature death among men [5]. The pathological background of the atherosclerosis of coronary arteries is the formation of atherosclerotic plaque, which additionally induces other cardiovascular diseases [6].

The main risk factors for CVDs are age, male sex, hypercholesterolemia (especially in case of cholesterol with low density lipoproteins (LDL)), smoking, systemic hypertension, and diabetes mellitus [7]. The majority of risk factors of CVDs are also considered to be risk factors for periodontal diseases (periodontitis) [8]. The role of inflammation in the development of atherosclerosis has been studied as well [9]. Studies found that atherosclerosis may be caused by several viral (cytomegalo virus and herpes virus and bacterial (Chlamydia pneumoniae, Helicobacter pylori) pathogens [10, 11].

A hypothetical relationship between damage to periodontium and atherosclerosis could be explained by the effect of a chronic inflammatory process on blood rheology, and a direct effect of active cytokines and activated lymphocytes and monocytes on the tissues of blood vessel walls [12,13]. Periodontitis is a chronic inflammatory disease that is characterized by a Th1 reaction and the release of cytokines (such as TNF-α and IL-β) [14,15]. It was determined that these cytokines also influence the development and progression of atherosclerosis [16,17].

Hypertension is also a very important risk factor for CVDs. Despite high prevalence of hypertension (as well as its immense prognostic value), there are few findings on the association between elevated blood pressure and the condition of the periodontium [18].

It was found that 1/3 of patients with hypertension have an abnormal increase in the left ventricular mass. It is known that left ventricular (LV) hypertrophy is associated with an increased risk for various CVD complications irrespectively of blood pressure and other factors [19].

The aim of the study: this study analyzed the relationship between blood serum lipids (as a well known CVD factor) and the condition of the periodontium, as well as the relationship between left ventricular mass index and the condition of the periodontium.

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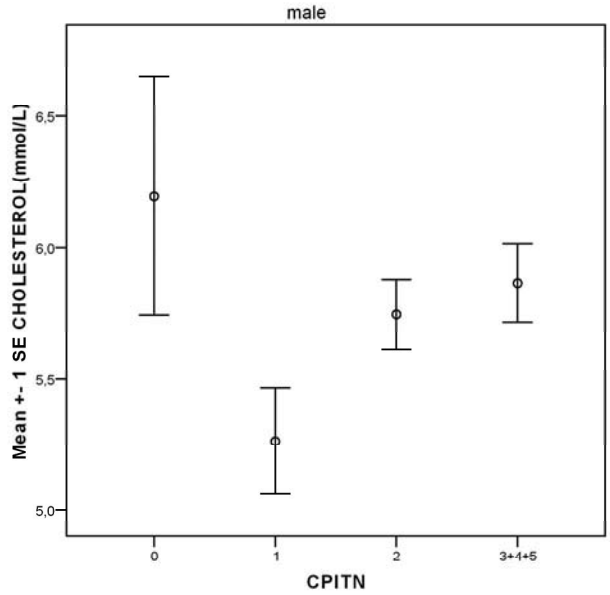

Fig. 1. The relationship of the CPITN index with total cholesterol

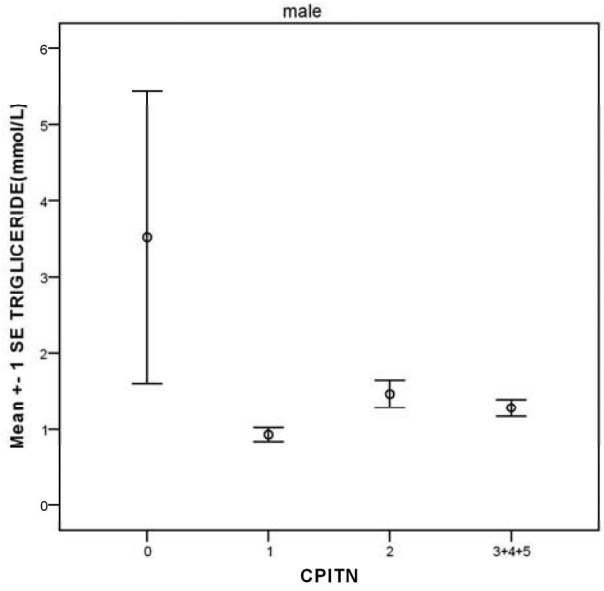

Fig. 2. The relationship of the CPITN index with trigliceride

MATERIAL AND METHODS

The study included 261 people – 140 women and 121 men. Mean age of the subjects was 38 years. The examination of the oral cavity was performed at KMU Clinic of Dental and Oral Diseases, laboratory blood lipid tests were performed at HKUM laboratory, and measurements of the subjects' arterial blood pressure, as well as cardiac ultrasound studies, were performed at KMU Clinic of Cardiology.

The condition of periodontal tissues was evaluated with the use of the CPITN (Community Periodontal Index of Treatment Needs) index [20]. The determination of this index was performed with the help of a stomatological mirror and a periodontal probe. The determination of the CPITN index was performed the following way: teeth in the lower and upper jaws were divided into sextants. One teeth of each sextant was examined (16, 11, 26, 36, 31, and 46).

The following codes were used in the evaluation:

Code 0 – healthy periodontal tissues;
Code 1 – bleeding after probing;
Code 2 – supragingival and subgingival calculus;
Code 3 – 4-5 mm deep pathological pockets;
Code 4 – 6 mm and deeper pathological pockets.

The findings of the study were recorded in a table; the biggest code for the examined tooth was recorded:

16	11	26
46	31	36

During tests at the HKUM laboratory, total blood cholesterol levels, as well as the blood levels of triglycerides, high-density cholesterol (HDL) and low-density choles-

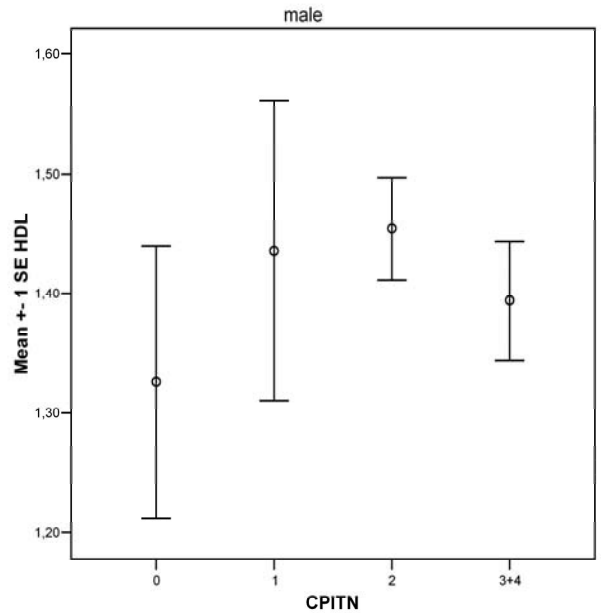

Fig. 3. The relationship of the CPITN index with HDL

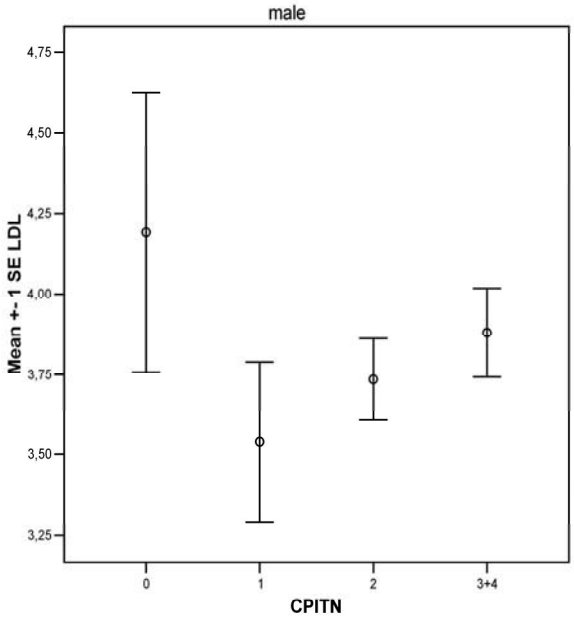

Fig. 4. The relationship of the CPITN index with LDL

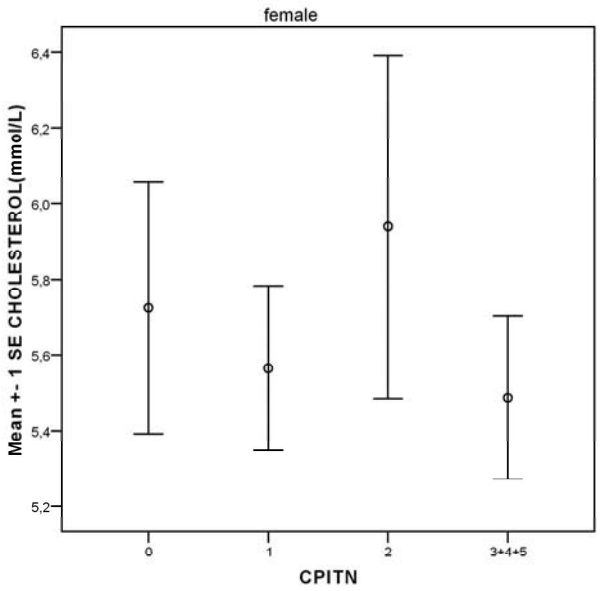

Fig. 5. The relationship of the CPITN index with total cholesterol

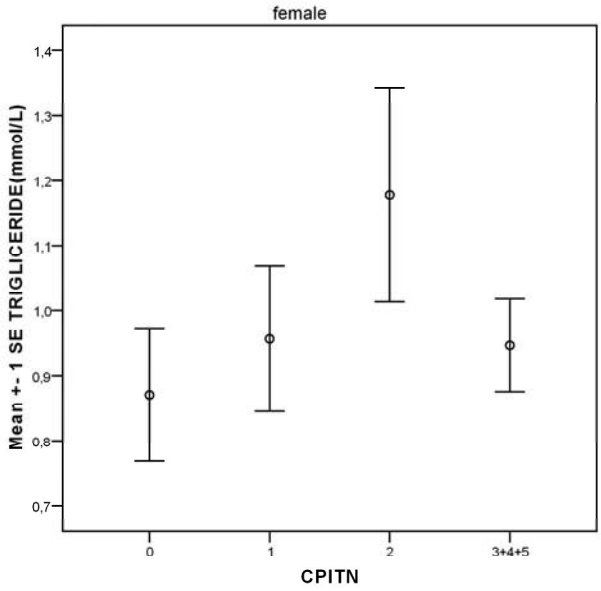

Fig. 6. The relationship of the CPITN index with trigliceride

terol (LDL) were determined (mmol/l).

When determining the relationship of the left ventricular (LV) mass index with the condition of periodontium, subjects with arterial hypertension (102 cases) were included into a separate group. Arterial hypertension was measured three times within one month. Arterial hypertension was diagnosed in cases when systolic blood pressure was 140 mm/Hg or higher, and the diastolic blood pressure – 90 mm/Hg or higher. These patients underwent cardiac ultrasound examination. During the examination, LV posterior diastolic diameter (mm), the thickness of the interventricular wall (mm), and LV posterior wall thickness (mm) were measured. On the basis of these findings, LV myocardial mass (LVMM) (g) was calculated according to the formula [21]:

$$LVMM = 1.04\,[(D + IVWT + LVPWT)^3 - D^3] - 14$$

D – LV posterior diastolic diameter;
IVWT – interventricular wall thickness
LVPWT – left ventricular posterior wall thickness
1.04 – cardiac muscle constant.

After the determination of LV mass, LV mass index (MI) was calculated (g/m^2) [22].

$$MI = \frac{LVMM}{BSA}$$

LVMM – LV myocardial mass
BSA – body surface area.

Statistical analysis of the findings was performed using software packages STATISTIKA/W5 and SPSS/W10

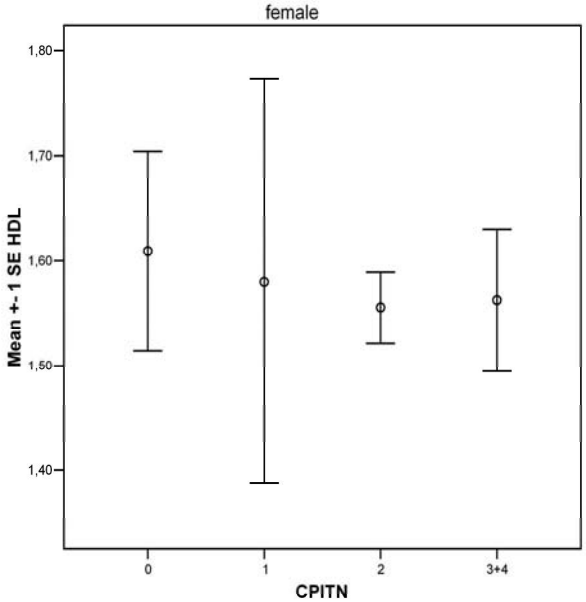

Fig. 7. The relation of the CPITN index with HDL

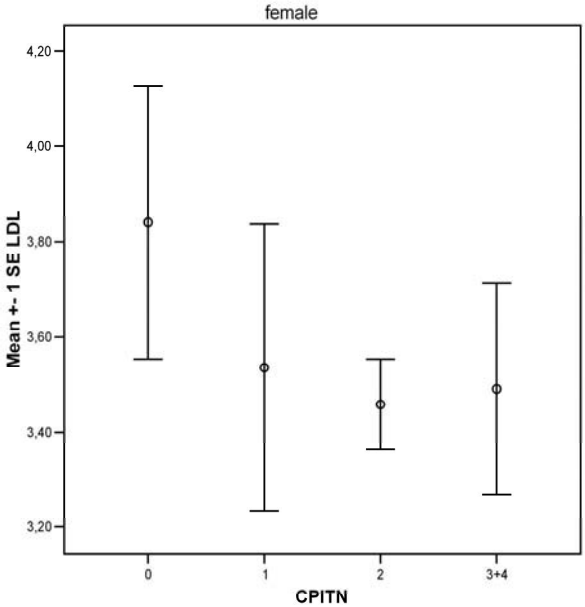

Fig. 8. relationship of the CPITN index with LDL

(statistical Package for Social Sciences) for document accumulation and analysis. The interrelationship of attributes was evaluated using χ^2 criterion, and the comparison of mean values was performed suing Student's t-criterion. When evaluating quantitative findings that did not have normal distribution, comparison tests for non-parametric values were used. Differences with significance level below 0.05 were considered to be significant.

RESULTS AND DISCUSSION

The statistical analysis of the findings, and the evaluation of the obtained results showed that in male subjects, mean total blood cholesterol level was 5.77±0.09, mean triglyceride level – 1.45±0.13, mean high density cholesterol (HDL) level – 1.42±0.03, and mean low density cholesterol (LDL) – 3.79+±0.08. The respective values in female subjects were 5.83±0.32, 1.1±0.11, 1.52±0.02, and 3.49±0.08.

The analysis of the relationship of blood serum lipids with the CPITN index in men yielded the following results: mean total blood cholesterol level at CPITN Code 0 (healthy periodontal tissues) – 6.19±0.45, at code 1 (bleeding after probing) – 5.26±0.2, at code 2 (supragingival and subgingival calculus) – 5.74±0.13, and at codes 3, 4 (4-6 mm and deeper periodontal pockets) – 5.86±0.14 (Fig. 1). The respective values for mean blood triglyceride levels were the following: CPITN Code 0 – 2.15±0.91, code 1 – 0.92±0.09, code 2 – 1.46±0.18, and codes 3, 4 – 1.27±0.11 (Fig. 2). Mean values for blood HDL levels were the following: CPITN code 0 – 1.32 ±0.11, code 1 – 1.43±0.12, code 2 – 1.45±0.04, and codes 3, 4 – 1.39±0.04 (Fig. 3). Mean values for blood LDL levels were the following: CPITN code 0 – 4.19±0.43, code 1 – 3.54±0.24, code 2 – 3.73±0.12, and codes 3, 4 – 3.88±0.13 (Fig. 4).

The analysis of the results in the group of female subjects yielded the following findings:

Mean total blood cholesterol level at CPITN Code 0 – 5.72±0.33, at code 1 – 5.56±0.21, at code 2 – 5.93±0.454, and at codes 3, 4 – 5.48±0.21 (Fig. 5). The respective values for mean blood triglyceride levels were the following: CPITN Code 0 – 0.87±0.1, code 1 – 0.95±0.11, code 2 – 1.17±0.16, and codes 3, 4 – 0.94±0.07 (Fig. 6). Mean values for blood HDL levels were the following: CPITN code 0 – 1.6 ±0.09, code 1 – 1.58±0.19, code 2 – 1.55±0.03, and codes 3, 4 – 1.56±0.06 (Fig. 7). Mean values for blood LDL levels were the following: CPITN code 0 – 3.84±0.28, code 1 – 3.53±0.3, code 2 – 3.45±0.09, and codes 3, 4 – 3.49 ±0.22 (Fig. 8).

Literature contains various findings about possible relationship between blood serum lipids and periodontal condition. Katz, J. et al. [23] indicate that in men, total blood cholesterol and LDL levels are significantly higher in patients with periodontitis (CPITN codes 3, 4), compared to patients with healthy periodontium and those with gingivitis (CPITN codes 0, 1, 2). These authors do not indicate significant findings in the groups of females. The association between periodontal condition, lipid concentration, and CVDs is indicated in other articles as well [24, 25]. Loesche, W. et al. [26] determined a significant association between, periodontal conditions and the concentration of triglycerides in blood.

Krause, S. et al. [27] states that hyperlipidemia causes hyperactivity of white blood corpuscles. It was determined that hyperactivity of white blood cells (e.g. increased production of oxygen radicals) may be associated with the development of periodontitis in adults [28].

Cutler, C. W. et al. [29] in their article stated that there exists a close relationship between damage to the periodontium, increased concentration of lipids in blood, and the presence of Porphyromonas gingivalis antibodies. Although the studied sample was small (26 people), this study showed that higher triglyceride levels might modulate the production of IL-Iβ polymorphonuclear leucocytes stimulated by P. gingivalis.

Morrison, H. I. et al. [30] in their article mention total blood cholesterol level, c-reactive protein, and fibrinogen as possible intermediate factors that associate periodontitis with increased risk for CVDs.

However, these findings do not allow for the determination of causality, i.e. whether periodontal diseases may increase blood lipid concentration, or hyperlipidemia exists as the same risk factor for periodontal diseases and CVDs [23].

Our study did not show any significant differences in blood concentration of total cholesterol, triglycerides, HDL, and LDL between people with healthy periodontium and those with gingivitis or periodontitis (in both male and female subjects). The results may have been influenced by the young age of the subjects (38 years) as well by the fact that this study did not analyze such aspects as physical activity, nutrition, experienced stress, etc. Similar findings were obtained in the study performed by Hujoel, P. P. et al. [31].

Our study also determined the relationship of LV mass index (in patients with hypertension) with the CPITN index. The evaluation of the obtained findings showed that mean LV mass index in subjects with healthy periodontium or with gingivitis (CPITN codes 0, 1, 2) was 92.92±2.7, while that in subjects with periodontitis (CPITN codes 3, 4) – 97.54±11.2. The comparison of these mean values did not yield any significant results. However, the Kolmagorov-Smirnov test showed an abnormal distribution, and the non-parameter study method was applied (Mann-Whitney test).

The results of the test were the following: mean rank value of the LV mass index in subjects with healthy periodontium of gingivitis was 48.3, while in subjects with periodontitis – 61.36 ($p<0.05$). Similar results were obtained by Angeli, F. et al. [32]. Possible mechanisms that associate LV mass index and periodontal condition are not fully understood. It is thought that in case of patients with hypertension, both hypertrophied heart and periodontium may be characterized by common microcirculatory dysfunction and rarefaction of the network of arterioles and capillaries.

Elevated pressure may play a role in the development of LV hypertrophy and general narrowing of the lumen of micro blood vessels. This may result in ischemia on the levels of both the heart and the periodontium [33].

Thus, a simple evaluation of the periodontal condition may be useful for the evaluation and specification of CVDs when examining patients with hypertension.

CONCLUSIONS

1. The concentration of total cholesterol, triglycerides, HDL, and LDL in blood serum did not differ significantly in people (either males or females) with healthy periodontium, gingivitis, or periodontitis.

2. The evaluation of the association of the LV mass index with the CPITN index (in patients with hypertension) yielded the following results: mean rank value in people with healthy periodontium or with gingivitis (CPITN codes 0, 1, 2) was 48.3, and in people with periodontitis (CPITN codes 3, 4) – 61.36 ($p<0.05$). The LV mass index elevated with the increase in the degree of damage to periodontium (the results were significant).

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