

# The Comparison of Stationary Bike Training and Standard Treadmill Therapy in Overweight and Obese Patients Age 40-55 with Peripheral Artery Disease (PAD) in Fontaine's Stage IIa on High Dose Supplementation Support of Alpha-Lipoic Acid (ALA)

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**Abstract Aim:** The aim of the applicative study was to estimate the increasing capability of claudications distance in Fontaine's stage IIa patients of Peripheral artery disease (PAD) with Body Mass Index (BMI) 25-34,9 kg/m<sup>2</sup> and Ankle Brachial Index (ABI) 0,8-0,9 by comparing Stationary Bike on High Dose of Alpha-Lipoic Acid (ALA) versus Treadmill walking program on standard Dose of Alpha-Lipoic Acid (ALA) in Exercise Therapy with life style modification. **Patients and methods:** This study was conducted from beginning of May, 2017 till end of May, 2018 at the Clinic for Cardiovascular Surgery Clinical Center and Department for vascular and endovascular surgery, University of Sarajevo, Special Hospital dr. Solakovic, Sarajevo and Faculty of Sport and Physical Education, University of Sarajevo. In the study included 60 male patients, age 40-55 with Peripheral Artery Disease (Ankle Brachial Index/ABI) 0,8-0,9, and Body Mass Index (BMI) 25 to 34,9 kg/m<sup>2</sup> (30 non surgical treatment patients on standard Treadmill walking program (control group) and research group consisting of 30 non surgical treatment patients on Stationary Bike), in stadium IIa of peripheral artery disease, with manifestation of mild claudication symptoms. For the testing of statistical significance of differences between the examined groups parametric tests were used. The difference at a level of (p<0,05) was statistically significant. **Results:** Analysis shows the no statistically significant difference between on claudication distance in Stationary Bike groups and impellers standard Treadmill walking group (p>0,05). **Conclusion:** Stationary Bike Interval Training can be alternative vascular Therapy and has his on benefits but he can not entirely replace Treadmill Therapy in Patients with Peripheral Artery Disease with BMI 25-34,9kg/m<sup>2</sup>. Treadmill Rehabilitation Therapy still remain generally main strategy of the therapeutic effect on enhancement of claudication distance (Fontaine's stage II) of peripheral artery disease.

**Keywords:** stationary bike, treadmill therapy, Peripheral Artery Disease (PAD), claudication distance, BMI 25-34,9kg/m<sup>2</sup>

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## 1. Introduction

Medicamentous and operative therapy in treatment of peripheral artery disease (PAD), clinical pictures of claudication etiology is precisely established. However, vascular therapy rehabilitation in certain levels of peripheral artery disease clinical picture of claudication

distance is in constant oscillations depending on comorbidities and risk factors (artery hypertension, diabetes mellitus, angina pectoris, obesity, insulin resistance, as well as limit of individualisation of rehabilitation performance of patients themselves [1,2]. Obesity is metabolic disorder with a possibility of insulin resistance of epidemic ranges and independent risk factor for prediction of vascular diseases on all vascular systems. Obesity, as well as other risk factors carries an increased

risk for the development of PAD on system circulation, especially on coronary, cerebral, carotid arteries and lower extremities arteries, thus representing a seriously underrated problem of epidemic range [3,4,5]. Peripheral artery stenosis occlusive disease incidence is in a constant state of increase, especially with the increase of saturated fat acids consumption (trans fat acids), overly consumption of plain carbs (starch), lack of adequate physical activity (metabolic syndrome) alongside poorly developed diet [6,7]. Gardner et al. [8] in meta-analysis of 21 exercises for claudication disease point to optimisation that the best therapy claudication distance quality is obtained from exercises only after 6 months of intensive procedure, more than three times a week lasting more than 30 minutes alongside diet modification. Peripheral atherosclerosis occlusive disease is defined as a set of clinical symptomatology characterised by claudication hardships which physically enable the patient, thus disturbing the patient's lifestyle quality. Intermittent claudication is a symptom of insufficiency of hemodynamic, which is described as a pain during walking and/or climbing up an elevated terrain in muscle parts on the level of lower extremities segment [9,10]. Localisation of the pain is mostly on the level of lower leg, femoral and/or gluteal region (depending of hemodynamic level and anatomy localisation of the level of stenosis occlusive change of artery, and the level of compensation circulation developments) which occurs after a certain level of physical activity with lowering of pain immediately after the mentioned activity. Intermittent claudication pain of long distance, over 200m (Fontaine's scale Stage IIa) of free walking with the exception of diabetes mellitus as a following risk factor in patient anamnesis, is mostly associated with previous stage of clinical picture of levelling of peripheral stenosis occlusive disease. In most cases it depends on hemodynamic level of narrowing of arterial level involved where no operative and/or endovascular treatment has been indicated [11,12,13,14]. As it is already well known, there is clearly established scientific evidence of prospective multicentre and randomised studies that age, hypertension, hyperlipidaemia, diabetes mellitus, smoking, inadequate lifestyle and wrong diet habits are the main risk factors for the development and progression of peripheral artery stenosis occlusive disease. However, in anamnestic data of the patients, some of the main factors are overlooked as factors of the development of symptomatology of peripheral artery stenosis occlusive disease. Those factors are lack of physical aerobic or anaerobic activities, with no rational diet concept, as well as traditional and/or fast food lacking nutritive values with high levels of animal fats in their everyday diet [15,16].

In significant stenosis, sub stenosis or occlusions are distanced from aortic-iliac bifurcation, magistral blood vessels are hemodynamically endangers, and the preserving of muscle and nerve structures depends mostly from collateral or so called compensation circulatory system. The term collateral blood flow (lat. Vasa collateralia) encompasses side branches, which represent alternative way for blood flow [17,18]. Also, these blood vessels have potential to reach diameter of lumen of collateral artery which partially satisfies hemodynamic magistral peripheral circulations [19,20]. Collateral vessels can be the ones which pre-existed (which represent alternative to

the main artery) or newly-forms (due to pathological compensatory neoangiogenesis process). The level of functional damage, which forms after occlusion, depends on: occlusion localisation, metabolic needs of tissue under occlusion and the amount of the blood flow through collateral blood vessels which remains. The conditions for a more efficient development of collateral blood flow is etiology of the state of chronicity of hemodynamic occlusion of magistral blood vessel as a concept of conducting of quality physical aerobic activity habit. Claudication symptoms, alongside with obesity and diabetes mellitus result in more rapid progression of atherosclerosis on micro and macro circulation with damage to tissue, bone and ankle structure, followed by symptoms of uneasiness, paresthesions, and even additional pain which worsens psychological state of the patient [19-22]. Leg pain is provoked by insufficient blood flow in over 75% narrowing of artery blood vessel lumen in distal and proximal parts of lower extremities. That is manifested during walking, by disorder of hemodynamic of magistral and/or collateral blood vessels which are a component of system atherosclerosis and also corresponds with highly elevated predictor of risk from cardiovascular morbidity and mortality in one in 20 people of the age over 50. Significant influence of risk factors can lead to clinical picture deterioration, compromised flow until the state of critical ischemia of legs which demands emergency endovascular and/or surgical treatment [22]. Risk factors which additionally increase acceleration of system atherosclerosis pathogenesis process and increase the risk of peripheral artery disease formation are: diabetes mellitus, high blood pressure (over 140/90mm Hg), obesity, body mass index BMI over 30kg/m<sup>2</sup>, (overall cholesterol over 6,2 mmol/L with low levels of HDL and high LDL). What can also be regarded as a risk factor is positive family personal anamnesis, lack of physical activities and quality diet (diet rich in saturated fat acids with big percentage of starch and glucose in concept of diet habits in everyday diet without rational calorie intake). The patients with confirmed peripheral artery disease (PAD) with BMI>25kg/m<sup>2</sup> where no vascular revascularisation has been confirmed and/or endovascular procedure besides medicaments therapy is an indirect concept of walking programme and individualisation of aerobic intensity with remodelling of dietary concept [23-26]. Bicycle riding has an impact on general circular systems and improves heart vascularisation, heart function, and the function of collateral circulation. Therefore, obese patients with claudication difficulties could have greater or similar benefits from walking, treadmill running, depending on the intensity, and not longevity of exercises, having in mind the additional weight which has a destructive impact on bone-cartilage structure [27-34].

## **2.1. Exercise Prescription For Treadmill Walking Program For Patients With Peripheral Artery Disease (PAD)**

Initial training intensity is based on the scale and level of claudication pain with starting speed on treadmill for walking-running on a treadmill around 2,0mph (ca.0,3 km/h) with or without minimal inclination

(individual access to patients according to scale and level of pain). In starting phases vascular rehabilitation program should last up to 15 minutes with phases of gradual stretching, warm-up and breaks between the programmes. The aim is to enable the patient to walk with no difficulties for about 30-60 minutes without claudication pain, and clinical picture of ischemia of lower extremities [26].

The aim of this study is assessment of aerobic physical activity quality (interval training with stationery bicycle in comparison to therapy protocol of treadmill walking program) and to examine benefits of the dosage and sub-dosage of individual supplementation of Alpha lipoic acid (ALA) in both compared groups, to record benefits of possibility of increase of claudication distance and decrease of BMI with the help of two therapy methods with different doses of ALA (600mg in comparison to 1800mg daily) i.e. to enable more quality and safe transition from symptomatic into asymptomatic Fontaine's stage IIa of peripheral artery disease, and thus avoid potential surgical and/or endovascular treatment.

The aim of the study is to observe quality of benefits of stationery bicycle interval training with high level of supplementation with ALA (1800mg daily/close to athletic lipotropic doses) over standard therapy with treadmill protocol on standard daily therapy (of 600mg ALA) in patients with increased body weight and obese class I (moderately obese patients) with insulin resistance and peripheral artery disease according to Fontaine's stage IIa with (BMI 25-34,9kg/m<sup>2</sup>) and Ankle Brachial Index (ABI) 0,8-0,9.

Having in mind that the subject is postoperative observation of the patients with no modifications of ethic indicative medical treatment no ethical principle of this study has not been violated or additionally endangered. The research was conducted in accordance with Helsinki declaration from 2013.

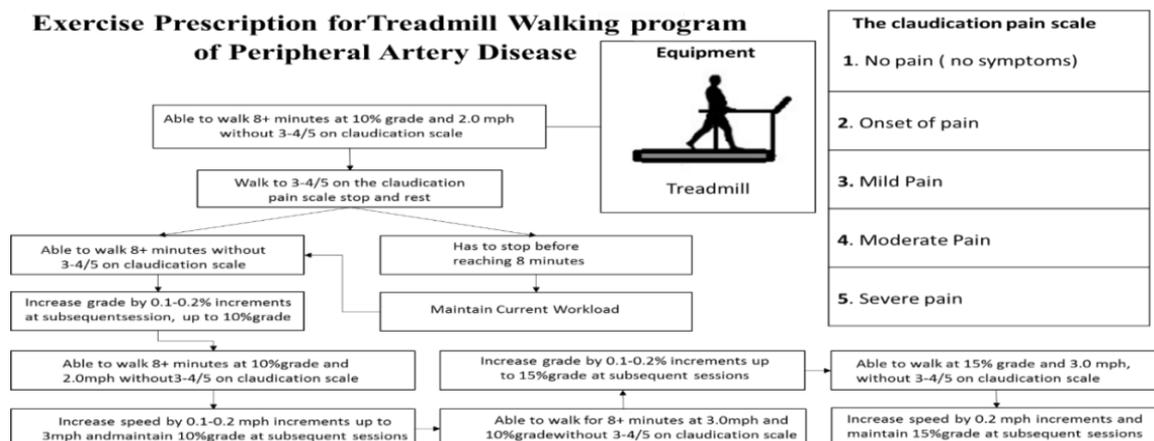
## 2. Patients and Methods

The research was conducted as a double blind prospective 12-month study in the period from May 2017 until May 2018. During this period the observed group of patients with peripheral artery disease of Fontaine's stage IIa with slight claudication symptoms. The study was conducted on the Clinic for Cardiovascular Surgery

Clinical Center and Department for vascular and endovascular surgery, University of Sarajevo, Special Hospital dr. Solakovic, Sarajevo and Faculty of Sport and Physical Education, University of Sarajevo. 60 male patients participated, of the age 40-45, with excessive body weight (BMI 25-34,9kg/m<sup>2</sup>). All patients had a verified micro and macro-angiopathy (circulatory weakness) which according to Fontaine have stage IIa of peripheral artery disease with slight manifestation of claudication symptoms with following risk factors (insulin resistance, with or without hypertension, with or without hyperlipidaemia, smokers and non-smokers), who fit into the criteria for study inclusion. Movement disability, i.e. lowered movement, obesity and unbalanced diet was also present in all 60 patients. All patients were acquainted with the criteria for inclusion into the study. The patients were divided into two groups. 30 patients were in one group, which participated in the programme of stationary bicycle on high doses of Alpha lipoic acid (1800mg daily with peripheral artery disease of Fontaine's stage IIa with BMI 25-29,9kg/m<sup>2</sup>) who had combined risk factors alongside insulin resistance syndrome, pre-diabetic state (research group). The second group consisted of the patients who are on a program of treadmill on usual doses of supplementation of ALA (600mg once per day with peripheral artery disease of Fontaine's stage IIa with BMI 30-34,9kg/m<sup>2</sup>) who had combined risk factors alongside insulin resistance syndrome, pre-diabetic state (control group)

In all 60 patients the diet has been remodelled (modified and enriched nutritive status), lowered calorie intake for 400-600kcal, increased intake of vitamin C (2000mg/daily) and vitamin E (800-1,200mg/daily) with increased Omega 3 intake (of 4 gr./daily).

Atrovastatins and Simvastatins were not used during the whole study. During the one-year period of research in both groups, i.e. in both stationary bicycle group (research group), and in treadmill program group (control group) no progress of the basic disease was recorded. Diabetic neuropathy, as well as presence and lack of sensitivity of lower extremities and feet were not clinically confirmed before or during the one-year research period. Before the start of the study, all patients were examined by medical team, led by vascular surgeon and sports-medicine team, and the same examinations were conducted after the research finished. All patients successfully finished the study.



**Figure 1.** Clinical practice guidelines of PAD for people with intermittent claudication developed by the Vascular Disease Foundation and AACPR [26]

### Our Stationary cycle reserching program concept of Peripheral Artery Disease in Fontaine’s Stage IIa

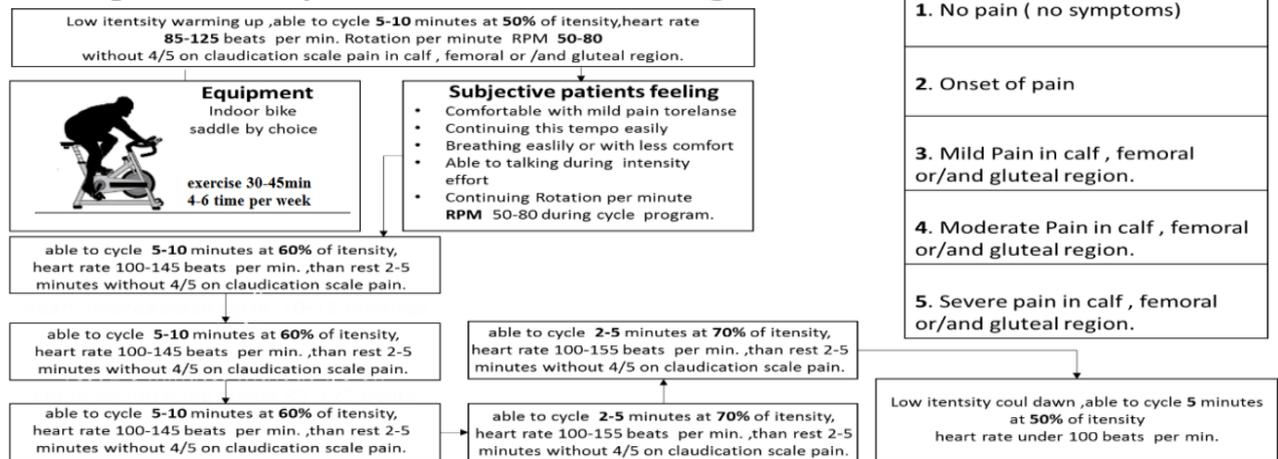


Figure 2. Our Stationary cycle reseaching program

Interval training program for the research group was made as described in Figure 2.

### 3. Results

In all examinees the measures of additional motivational efforts were conducted by engaged sports team by which the study was successfully finalised with various protocols of training process, different BMI values and dosage of ALA supplementation (1800mg and 600mg daily), Omega 3 and Vitamins C and E. During the study, the patients reported that physical activity objectively and subjectively gave them a feeling of satisfaction. Average amount of increase of self-initiated motivation for the research group with stationary bicycle started after (6,26weeks), while the average for the control group of treadmill users started after (7,81 weeks). Detailed analysis of the study was limited on the level of some minimal deviations which were done and included into statistical data analysis. In comparison analysis of the two groups, the research group on stationary bicycle (average ABI 0,81 and BMI 28,6kg/m<sup>2</sup>) and control group on treadmill therapy (average ABI 0,78 and BMI 30,1kg/m<sup>2</sup>) there were no statistically significant differences between the groups (p>0,05). By inspecting (Table 1 and Figure 3) it is visible that statistically significant number of examinees was confirmed of the age of 40-45 in both groups (control and research) and in 23 examinees (38,33%; p<0,05) with values of BMI 25-29,9kg/m<sup>2</sup>) and 37 examinees (61,66%; p<0,05) with values of BMI 30,0-34,9 kg/m<sup>2</sup>. The biggest number of patients in both groups (research and control) in conducted research had hyperlipidemia syndrome of insulin resistance and artery hypertension >130-150/80-100mm Hg.

Out of 29 patients in total (48,33%), 16 patients belonged to the research group and 13 belonged to the control group (p<0,05) (Table 2 and Figure 4). After the one-year study, in 35±2 (58,33%) patients normal values of blood pressure were recorded, out of which 16 patients of the research group and 19 patients of the control group. The remaining 25 (41,66%) patients, or 14 from research and 11 from control group had slightly higher values of blood pressure (Table 3, Figure 5). By inspection (Table 4 and Figure 6) of lipid status of the patients, it is evident that values of HDL>1,5mmol/L significantly increased after the one-year study in 37 (61,66%) examinees, out of which 24 examinees are from control group (Standard Treadmill Therapy) and 12 are from the research group (Stationary Bike Interval Training). There is also a visible decrease of LDL<3,0mmol/L in 18 examinees of both groups or (30%) with significant difference in favour of patients of the research group. Individual increased values Triglycerides >1,7mmol/L were recorded only in research group (Stationary Bike Interval Training). Statistically interesting result (Table 5 and Figure 7) was recorded in the group of patients with stationary bicycle in comparison to standard treadmill group, out of which 21 patients (35%) reached a level of BMI 18.5-24,9/kg/m<sup>2</sup> with average of 23,12kg/m<sup>2</sup> (p<0,05). Only 3±2 or (5%) patients from both groups kept BMI 30-34,9kg/m<sup>2</sup>; p>0,05). Moreover, 27 (45%) patients of stationed and treadmill programme group showed increase of claudication distance of over 2000 meters, which objectively categorizes the patients into working capable individuals (p<0,05). Slightly increased levels of claudication distance 2000m was recorded in control group 25%. In 7±2 patients or (11,66%) in both examined groups had no destructive symptomatic limit to specific individual distance (Table 6 and Figure 8).

Table 1. Representation of Age and BMI in Patients with PAD in Fontaine’s Stage IIa on Research groups before researching

Age and BMI (kg/m <sup>2</sup> )	Research Groups		Total
	Stationary Bike Interval Training	Standard Treadmill Therapy	
40-55 years (BMI 25-29,9)	14 (23,33%)	9 (15%)	23 (38,33%)
40-55 years (BMI 30-34,9)	16 (26,66%)	21 (35%)	37 (61,66%)

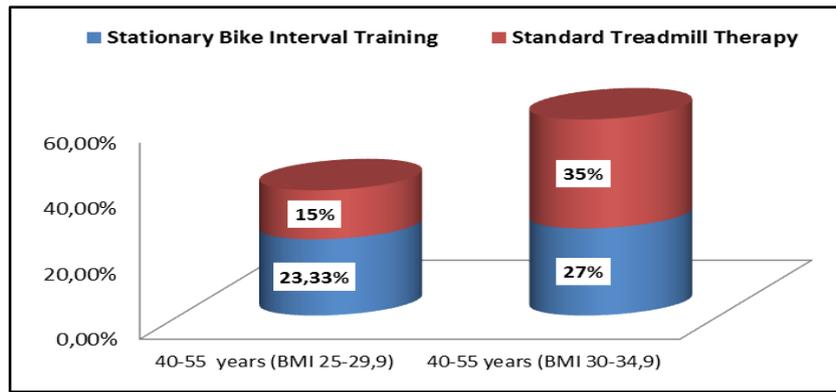


Figure 3.

Table 2. Representation of Risk factors in Patients with PAD in Fontaine’s Stage IIa with BMI (25- 34,9kg/m<sup>2</sup>)

Combbination of most common risk factorsin Overweight and Obese Class I (Moderately obese) Patients with Peripheral Artery Disease in Fontaine’s Stage Iia	Research Groups		Total
	Stationary Bike Interval Training	Standard Treadmill Therapy	
Hyperlipidemia, smocking, Insuline resistance syndrom, Hypertension <130-150/80-100mm Hg	12±2 (20%)	14 (23,33%)	26±2 (43,33%)
Hyperlipidemia, Insuline resistance syndrom, Hypertension >130-150/80-100mm Hg	16 (26,66%)	13 (21,66%)	29 (48,33%)
Smocking , hyperlipidemia, Insuline resistance syndrom	2±1 (3%)	3 (5%)	5±1 (8,00%)

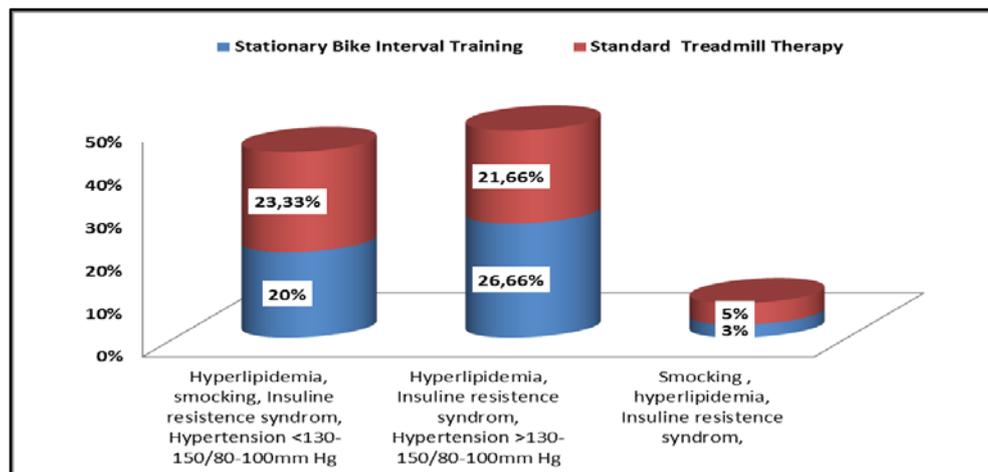


Figure 4.

Table 3. Evaluation of systolic and diastolic blood pressure status after one year of researching

Blood pressure status after one year of researching	Research Group		Total
	Stationary Bike Interval Training	Standard Treadmill Therapy	
120-130/80-90mm Hg	16±2 (26,66%)	19 (31,66%)	35±2 (58,33%)
130-140/80-90mm Hg	12 (20%)	6±2 (10%)	18±2 (30%)
140-150/80-90mm Hg	2 (3,33%)	5 (8,33%)	7 (11,66%)

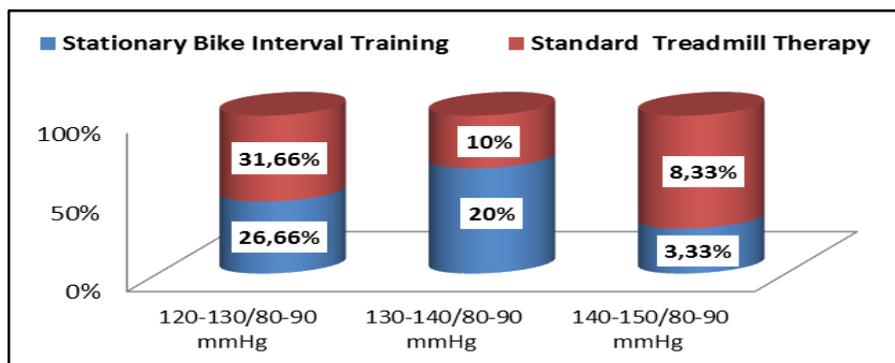
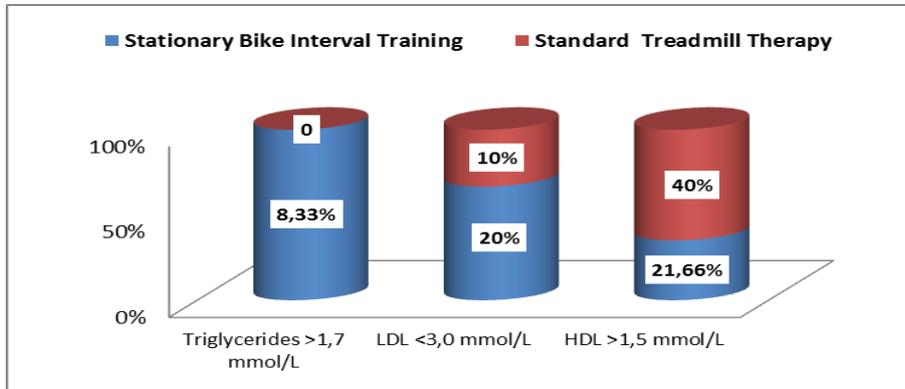


Figure 5.

**Table 4. Evaluation of Lipid status after one year of researching**

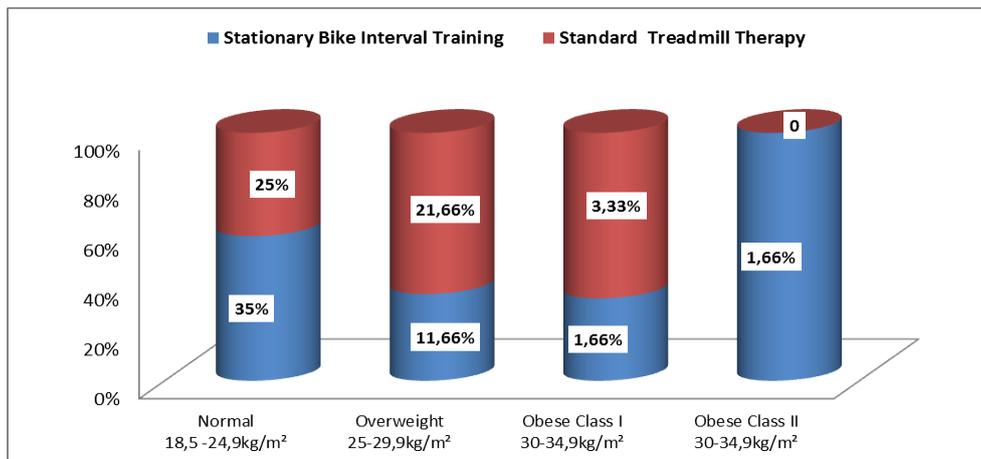
Lipid status status after one year of researching	Research Group		Total
	Stationary Bike Interval Training	Standard Treadmill Therapy	
Triglycerides >1,7 mmol/L	5 (8,33%)	0	5 (8,33%)
LDL < 3,0mmol/L (Low-density lipoprotein)	12 (20%)	6 (10%)	18 (30%)
HDL > 1,5 mmol/L (High-density lipoprotein)	13 (21,66%)	24 (40%)	37 (61,66%)



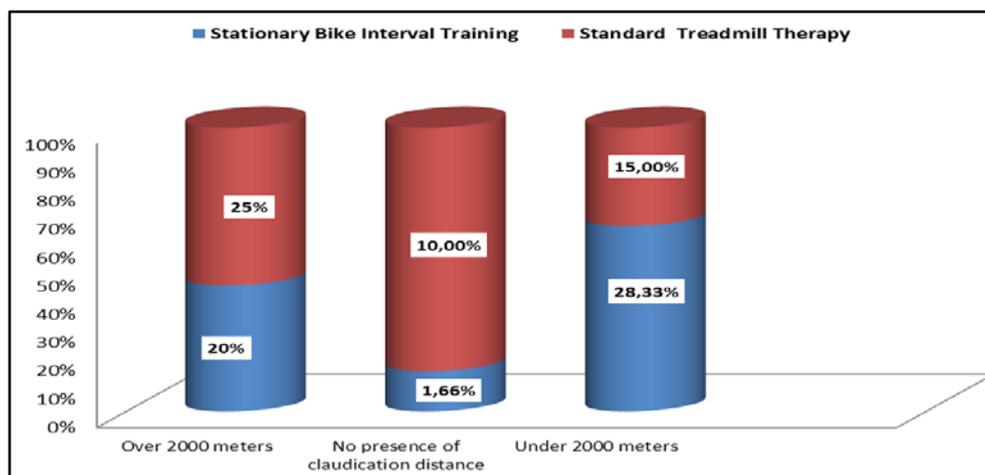
**Figure 6.**

**Table 5. BMI (kg/m<sup>2</sup>) in Patients with PAD in Fontaine’s Stage IIa on research group after one year of study**

Body Mass Index (BMI/kg/m <sup>2</sup> )	Research Groups		Total
	Stationary Bike Interval Training	Standard Treadmill Therapy	
Normal (healthy weight) 18.5 -24,9	21 (35%)	15 (25%)	36 (60%)
Overweight 25-29,9	7±2 (11,66%)	13 (21,66%)	20±2 (33,33%)
Obese Class I (Moderately obese) 30-34,9	1±2 (1,66%)	2 (3,33%)	3±2 (5%)
Obese Class II (Severely obese) 34,9-39,9	1 (1,66%)	0	1 (1,66%)



**Figure 7.**



**Figure 8.**

**Table 6. Testing the presence of claudication distance in Patients with PAD in Fontaine's Stage IIa with BMI 25- 34,9 on research group after one year of research**

Claudication distance	Research Group		Total
	Stationary Bike Interval Training	Standard Treadmill Therapy	
Over 2000 meters	12 (20%)	15 (25%)	27 (45%)
No presence of claudication distance	1±2 (1,66%)	6 (10%)	7±2 (11,66%)
Under 2000 meters	17 (28,33%)	9 (15%)	26 (43,33%)

## 4. Discussion

Physical activity prevents and slows down the development of peripheral artery disease (PAD), and in synchronisation improves the effect of primary vascular medicament and/or reconstructive-medicament therapy. Peripheral artery disease is a disease with the biggest incidence and prevalence and at the same time it is the most studied pathogenic and clinical entity in the beginning of the third millennium. Claudication difficulties of Fontain's stage IIa which the patients names represent relative indication for surgical treatment. In most of the patients which modify diet and apply the concept of good quality physical activity along side medicamentous therapy, the difficulties do not worsen, therefore the decision for the establishment of indication of surgical treatment is delivered individually. The patient younger than 50 who have aggressive form of atherosclerosis also have poorer outcome of the surgical treatment, which often requires revision of the vascular procedure itself (endovascular and/or surgical) or replacement of synthetic and/or autologous veingraft [5,14,34,35,36]. The risk of the loss of extremities in patients with claudication difficulties is 1% per year and in 20% of the patients they worsen when artery reconstruction is needed and/or endovascular procedure. Civilisation atherosclerotic diseases are more and more present, and to stop them or at least slow them down is one of the most important tasks of our health system at the moment and because of the expansion of ischemia individuality in the future. The role of physical activity and sport in preserving of normal physical functions of human organism, as well as secondary preventions, therapy and rehabilitation remains an important and irreplaceable factor [9,10,17,18]. Artery peripheral stenosis occlusive disease is a disease which is best treated in combination with medicaments and/or surgical therapy (depending on the clinical picture, level and stage of artery damage, as well as danger for the extremity which suffers from the disease itself) and physical rehabilitation which improves psychological and physical parameters of an individual, by remodelling their everyday life and improving the significance of self-importance and vitality. Calorie consumption by walking cca 4 miles in 30 minutes for 400 calories on average varies depending on the intensity and elevation of the treadmill. Even though calorie superiority of the consumption and benefit of the therapy are confirmed in artery patients by walking on the treadmill stationery bicycle therapy in the same disease still represents the alternative form of therapy with its own benefits and ways of prevention of various diseases in the backgrounds. Benefits mechanism model of athletic performance in athletes, as well as in the patients with claudication difficulties of over 200, distance of free walking (Fontain's stage IIa) ABI 0,9-0,8 after diagnostic

assessment of the overall state of the patient and presence of comorbidities which do not require operative treatment is individually targeted sports-therapy training which aims to improve the concept of the required performance of movement biomechanics on a daily basis [17,37]. One important part of the phase of supracompensation is vasodilatation of microcirculation, improvement in elasticity of blood structures, as well as improvement of collateral (alternative) circulation, which is an important factor for the preservation of vitality of tissue structures which are affected by stenosis occlusive artery disease [22-25]. Pre-diabetes state, as well as diabetes mellitus itself is an extreme risk factor which often speeds the process of atherosclerosis diseases, definitely shortens life quality with present neuropathy which appears in 50% diabetes patients. Treatment with ALA 600mg daily is indicated in diabetes patients with micro angiopathy who have good tolerance of glucoses. It is a very effective cure in treatment of the patients with sensory neuropathy; it gives a quality therapy benefit in patients with HbA1C below 7%. In comparison with the patients with HbA1C >7%, and for the reason of lowered dose (sub-dosage) therapeutic potential of ALA in patients with claudication difficulties and high BMI was not adequately metabolically used [38,39]. It is scientifically confirmed that using of ALA doses of 1800mg daily significantly lowers the weight in obese patients with BMI >30 kg/m<sup>2</sup> in cases of good tolerance of the dose. Side-effects were not recorded during the 30-year study, except the sensitivity of the stomach to medication consumption on an empty stomach. Acute toxicity of the body is gained in doses of 400-500mg/kg of body weight, so with patients on high doses of ALA no side-effects were recorded, as well as with the doses of 600mg of standard dose which was prescribed in the treatment of diabetes neuropathy of difficulties with circulation alongside increased BMI. During this one-year study no side-effects were recorded of oral application of ALA (nausea, sickness, diarea, signs of intoxication, etc.) in the patients treated with high dosages, nor the patients with normal doses of ALA [4]. There are individual data, but it cannot be classified as scientifically confirmed, according to all scientific rights of research, that dose of ALA of 1800mg daily in combination with conjunction linoleum acid (CLA) and adequate continuous physical activity gives quality results in therapy of obese patients with peripheral artery disease of claudication symptomatology, and that it shall improve metabolism and improve therapy effect of BMI reduction with an accent on subjective state of artery hemodynamic. However, further studies are needed and the sample of patients which could support such study and confirm the theory officially. The performance is subjective alongside classic therapy and performance of supplementation of ALA and CLA in the decrease of symptomatology of peripheral artery disease, with accent on risk factors and

comorbidities. The benefits of high doses of ALA significantly influence the metabolism and improve the quality of carbs usage on the level of mitochondria and in patients with peripheral artery disease, which has been proved in our study. In the study of Haak et al. [41] it has been shown that the patients who suffer from diabetes neuropathy have extremely long-term benefits from the use of therapy doses (ALA), namely 600mg (daily), as well as acute benefit on microcirculation, whose mechanism is not entirely clear. However, during this study the sole benefits of positive reflection on the decrease of the level of Haemoglobin HgbA1C have not been confirmed. ALA is needed to turn carbs into energy so it can speed up the processes of production in muscle cells, especially in mitochondria. In comparison to other substances, vitamins, ALA has the biggest spectrum of anti-oxidation in comparison to vitamins C and E and it can penetrate into all parts of the body in terms of dihydric-alpha lipoic acid, which gives even greater effect potential to the body. Also, muscle sensitivity to insulin increases, and through stimulation of GLUT1 and GLUT2 glucose of transporters the intake of dependant and independent carbs increases on insulin and musculature from which diabetic and non-diabetic population therapeutically has benefits [41,42]. Sanderson, et al. [43] in his six-month long study did not point to therapy benefits of claudication distance increase in patients during the research, but ALA significantly increased quality performance of walking dynamics with lowering of claudication pain. Moreover, he points to the benefits of treadmill in patients with diagnosed peripheral artery disease who do not have claudication difficulties, and that the best therapeutic benefits are based on individual concepts with accent on comorbidities and risk factors, as well as with individual concept of physical therapy with quality surveillance of vascular surgeon, sports doctor and/or physiatrist.

Therapy limitness of physical therapy are comorbidities which often have limiting possibility of physical therapy itself, and because of the following diseases (myocardial infarction, angina pectoris, heart weakness, cardio-myopathies, chronic obstructive lung disease, arthritis, diabetes mellitus, obesity), such patients are recommended mild physical activity (mostly walking, low intensity, frequent continuity) alongside strictly indicated medicament therapy [44,45]. Short studies have showed that due to oxidative stress in early phase of cardiovascular disease, ALA treatment can have significant benefit, however there is a lack of long-term studies which can confirm this statement. De Oliveira et al. [46] in their study of the patients with diabetes mellitus type II proved the benefits of sensitivity to insulin after a month of oral application treatment of 600mg ALA (once a day) without an efficient impact on the level of fat in blood. The patients with resistance to insulin would benefit from this especially. Zhang, et al. also names benefits of successfulness on the level on lipid parameters with no effects of influence on the values of Haemoglobin, HgbA1C [46,47]. The main benefits of our one-year study was that treatment of average claudication difficulties of conservative Fontaine's stage IIa and obesity by stationary bicycle with high doses of ALA of 1800mg daily have impressive effect on

circulation improvement, carbs and fat metabolism in patients of the age of 40-55, with peripheral artery disease, resistance to insulin. Moreover, it significantly improves the treatment of weight reduction, in comparison to standard treadmill therapy, in treatment of claudication symptomatology with dose of (ALA) of 600m daily. Although standard treatment of 600mg ALA has financial advantage over 1800mg daily treatment, it gives significantly better results in obese patients in adequate physical concept. Based on these results, we think that standard therapy dose of 600mg was sub-dosed in especially obese patients of the age from 40-55 with claudication distance and with adequate concept of physical activity with stationary bicycle. Moreover, we can say that high doses of (ALA) with monocyclic treatment of stationary bicycle on comparison to treadmill program and low doses of ALA stabilises and improves therapy levels of HDL, LDL and Triglyceride alongside adequate conceptual diet with support of high and continuous supplementation of Omega 3 fatty acids (N-3) [48,49].

## 5. Conclusion

The results of the study showed that therapeutic benefits of the study were recorded in patients from both groups (stationary bicycle and treadmill). However, the improvement of claudication distance was slightly better in the patients from the treadmill group. Even though stationary bicycle, according to our findings, was the first choice in treatment of claudication difficulties and central obesity in obese patients (BMI 25-34,9kg/m<sup>2</sup>) in combination with high doses of Alpha lipoic acid (ALA), by modification of nutritive state, and increased intake of Omega 3, Vitamins C and E, it eventually was evident that therapy with treadmill has advantages because it showed greater benefits of improvement of claudication distance in comparison to the treatment with stationary bicycle. We can say with certainty that only disease and pointers of the treatment are not key factors in therapy conducting. Improved motivation is one of the leading key and irreplaceable factors of therapy protocol of claudication difficulties.

## Conflict of Interest

The authors declare no conflict of interest.

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