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RESEARCH ARTICLE

Therapeutic Measures from Cardiovascular Damage using Statins, Acetylsalicylic Acid during the Abuse of Irrational Cycles of Anabolic Steroids in Bodybuilder Who Were Infected with the COVID-19

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ABSTRACT

Introduction: We are increasingly witnessing the self-initiated, uncontrolled stacking of incompatible anabolic substances in various cycles in the young Balkan Recreational Bodybuilding population group, increasingly frequent acts of violence in our country and the emergence of a neglected and very silent epidemic that is taking on an increasingly aggressive course of illness and psychological behavior. Black market anabolic steroids are associated with many generally health problems and uncontrolled aggression behavior by abusers. Young unsolicited recreate bodybuilding are also associated with generalized atherosclerosis and potential increased high risk for heart disease that can structural and functional damage the cardiovascular system during muscle mass steroid cycles. Besides high calorie intake, elevating serum blood lipid cholesterol levels LDL lowering HDL levels, elevating, systolic and diastolic blood pressure take a certain participation in cardiovascular risk and therefor need a development of certain cardiovascular protection strategies for this avoiding medical supervision anabolic steroids abuser group which are not yet appropriate established. **The aim of** the short study was to estimate Cardiovascular Protective Strategy Measures on lipid levels, and blood pressure status in a young recreational bodybuilder with different ethnic groups who Abuse Anabolic Steroids during controversial and different mass Cycles with and without taking Polyunsaturated Fatty Acids and Acetylsalicylic Acid (ASA) and Statins.

Subjects and methods: This study was conducted from beginning of January, 2022 till end of July, 2022. 140 subjects are included age 17-30 (74 male Recreational Bodybuilder Who Abuse Anabolic Steroids on Simvastatin's 10mg and Acetylsalicylic Acid 150mg doses of (ASA) and 10 grams of Polyunsaturated Fatty Acids during mass Steroid Cycles and 66 impellers group of male Recreational Bodybuilder Who Abuse Anabolic Steroids consisting without consume Statins and Acetylsalicylic Acid (ASA) during mass Steroid Cycles). For the testing of statistical significance of differences between the exanimated groups non-parameter and parameter tests were used. The difference at a level of $p < (0,001)$ was statistically significant. Results: In all the tested subjects we investigated increasing lipid levels and blood pressure after six months of study. Analysis shows the statistically insignificant influence of antiplatelet therapy (150mg Acetylsalicylic acid) (ASA), combined with Simvastatin 10mg $p < (0,001)$ in steroid abuse subjects during irrational muscle mass steroid cycles.

Conclusion: Lack of familiarity with combinations of anabolic substances, as well as the danger of oral applications of very harmful steroids from the former Soviet Union and German Democratic Republic (GDR), this study showed. Avoidance of physician supervision by recreate bodybuilders by deceiving of the athletic subjectivity look, seams appears almost always in gym. This cardiovascular protective measures have poor benefit appeared to be usefully blind preventing strategy of controlling blood lipid levels during muscle mass steroid cycles, with no guaranty of worsen cardiovascular condition by abusing anabolic steroids. The influence of the reflection of the COVID 19 virus on such dramatic therapeutic results in this population group of two groups cannot be ruled out for sure.

Keywords: Anabolic Steroids, Recreational Bodybuilder, Cardiovascular, Statins (Simvastatin's), Acetylsalicylic Acid (ASA), Polyunsaturated Fatty Acids.

Introduction

Uncontrolled and irrational Abuse of anabolic steroids in our country and in the world is a neglected phenomenon of society and a very silent epidemic that has devastating consequences for the individual and his social environment, which provides increasingly intensive medically poorly and insufficiently researched information and topics about consumption and application via video media and social networks¹⁻³. The tempting, fast and effective benefit of abusing anabolic steroids in young recreational athletes leaves its lasting, quiet and permanent trace on the destruction of the cardiovascular system including disturbances in mental behaviour¹⁻⁵. One of the most important and serious consequences of long-term, decades-long consumption of anabolic steroids is damage to the cardiovascular system, which is directly correlated with ischemic heart disease, arterial hypertension, hyperlipidaemia, increase in homocysteine, cardiac arrest, polycythaemia and cardiac cardiovascular incident. Increasing or thickening of the left ventricle is of pathological ethology when consuming anabolic steroids and goes well beyond the benign compensatory pathophysiological sport mechanism, which tends to retrograde withdraw during monitoring and lowering of muscular load and exercise intensity⁵⁻⁸. Decade-long administration of anabolic preparations causes enormous left ventricular hypertrophy and can lead to heart failure with damage to heart muscle cells and impaired electrical conduction of the heart (arrhythmias) leading to a person with a disabling condition or even to end with a lethal outcome⁸⁻¹². Consumption of anabolic steroids disrupts the mechanism of blood viscosity, which, in correlation with platelets,

erythrocytes and fats in blood vessels, destructively affect the endothelium of the blood vessel itself, accelerating the process of atheromatosis and polycythemia, which kills the pathological process in the formation of predominantly unstable plaque. In addition to endothelial destruction, anabolic steroids tend to raise systolic and diastolic pressures, and they are hypertensive and vasodilatory, predominantly in the deep vein and varicose in the superficial vein system¹²⁻¹⁴.

With elevated arterial systolic and diastolic pressures, anabolic steroids potentiate a higher incidence than a cardiovascular incident, especially oduring steroid mass cycles where the caloric intake of amino acids, proteins, carbohydrates, and saturated fatty acids is well above the limit of individual normality. Considering that beginners during the consumption of anabolic steroids are preoccupied with the beauty of the subjectivity of hypertrophy of muscle mass, that is, the "Adonis complex", there is little individual attention from consumers on the potential adverse effects of black market anabolic preparations¹⁵⁻¹⁹. Many negative permanent damage to vital organs and hemodynamics have been reported in individuals and observed subjects in studies over the years. One of the options for preventative protections for young recreational athletes is the Statin application, which has the potential benefit in cardiovascular patients of reducing arterial pressure and total cholesterol and LDL levels. Changes on the lipid level are significantly recognized in the application of various synthetic forms of testosterone and in various types of cycles and applications (intramuscular/oral). The acceleration of the atheromatosis process of certain illicit substances of

synthetic testosterone of different esters in the younger population is still under delicate scientific investigation. Despite a large number of dedicated Statin studies, little attention has been paid to the young bodybuilding population, which, without consulting and supervising physicians (self-initiated or through dealers), apply combinations of various types of substances of questionable and unproven quality, stacking, without paying attention to hematological and lipid laboratory values, nitrogen matter, PTT-a and INR values as well as vital parameters. Although atherosclerotic risk groups are now known worldwide and generally adopted by the WHO, the young recreational bodybuilding population which continues to abuse the black market anabolic steroids and similar substances has a serious tendency to approach the atherosclerotic population. Thus, it takes the place of a young cardiovascular population group of the modern age of unobserved epidemiological proportions with a continuous tendency of increasing limited scientific data for each country ¹⁴⁻¹⁹.

AIM OF STUDY

The aim of this study is to gain original insight into the benefits of high-dose unsaturated fatty acids use of 10gr and use of 10mg Statin (Simvastatin) with the use of acetylsalicylic acid 150mg (ASA). The intention is to try to prevent young recreational bodybuilding population in the form of cardiovascular protection during the cycle conducted to gain muscle mass, in order to suppress the potential side effects of steroid application and the initial process of atheromatosis, further development of atheromatosis and further pathology of atherosclerosis, and thus pre-atherosclerosis pathology cardiovascular incidents. Also, although we are not able to legally ban the consumption of anabolic steroids from the black market, the study gives us a scientific wide spectrum of consumption, as well as an insight into lipid and mental status, as well as the benefit of cardiovascular protection.

ETHICAL RESEARCH CONSIDERATION

The proposed concept of protective conservative action is based on an understanding of the potential and threatening cardiovascular incidents as well as the preventive effects of cardio-protective substances. There are limited studies because of the inaccessibility of data, the precise information about types of substances and to what extent

recreational users consume them, as well as the individual combinations and cycles of the young recreational bodybuilding population in the 17-30 age groups. For some subjective reasons, science and practice are often confronted with the fact that young recreational bodybuilders often deny the consumption of anabolic steroids, and being deceived as they consider the subjective appearance as a reflection of a key health parameter that precludes any medical supervision or consultation. Considerable alternative measures of application of anabolic products in the form of ethical principles of the professional pharmacy and sports profession were conducted and multidisciplinary discussions with each of the individuals, self-initiated subjects of this study, were done namely about the consequences of adverse effects on health due to the self-initiated application of anabolic steroids without consultation and supervision of a physician (specialist).

Methods

PARTICIPANTS AND EXPERIMENTAL DESIGN

The study is based on a lack of data on a new potential cardiovascular population group, and includes a short retrospective multicentre study of anabolic steroid users, a recreational population group without competition motivation. The study included a total of 140 subjects who regularly orally or intramuscularly administered anabolic preparations over a 6-month period. The study was started after a cleansing period of 6 ± 2 months, individually, with a start of consumption no more than three years ago. All patients had borderline low HDL findings and high LDL findings with elevated total cholesterol.

The study group consisted of 74 patients and control group consisted of 66 patients aged between 17 and 30 (mean 24.56 years of age in the study group and 25.89 years of age in the control group) included in the annual recreational anaerobic fitness program (weightlifting and/or using devices for individual or systemic muscle groups with maximal and/or submaximal repetitions of 3-6 reps) 4-6 times with the duration of 60 minutes to 160 minutes per week, with the concept of training to achieve subjective muscle mass and muscle strength. The benefits were statistically compared: in the study group of 74 subjects, with simvastatin 10mg daily, acetylsalicylic acid (ASK) 150mg daily (2x 75mg every 12 hours) and high doses of semi-saturated fatty acids 10g daily.

The control group included 66 non-consuming subjects. The average consumption of anabolic steroids for the study group on cardio-protective therapy is 1.21 years, and the average consumption of anabolic products for the control group is 2.32 years. The data were collected between January 2022 and June 2022 at the Health Center, Sarajevo, Bosnia and Herzegovina, Faculty of Sport and Physical Education University of Sarajevo, Special Hospital Dr. Solakovic with a follow-up period of 6 months. All patients completed the study, there were no lost to follow up patients. It is important to note that oncological, coagulopathy, haemophilia, as well as any other cardiovascular diseases (angina pectoris/arrhythmias/venous and arterial thrombosis of the lower and upper extremities/coagulopathy) in the background were not recorded in all subjects.

All subjects were given the concept of freedom of nutrition, which also included the occasional traditional national Bosnian fast food, with the freedom to use nutritional supplements of their choice in the form of daily, weekly or monthly dietary implementation with periodic monitoring of caloric intake and dietary restriction. During the aerobic (cardio) training concept during the 6-

month test (bicycle/treadmill/orbitrek) any of the mentioned activities were not recorded in either the tested or the control group. All examined participants in the study overcame a COVID 19 infection with milder or more severe symptoms without damage to the cardiovascular system by the virus. Experts from Ukrainian scientific institutes from multidisciplinary scientific fields were involved in this short study.

Results

The results of the research of both groups are contained in Tables (1 - 4). Table 1 and 2. contains the results of the characteristic cycles in the groups that compare the group of anabolic steroids With the use of statins, (ASK) and fish oil (study group) and the results in the groups that compare the anabolic steroid groups Without the use of statins and (ASK), fish oil (control group). Table 3 contains the numerical parameters of the anabolic steroid cycle differences between the groups with the use of statins (ASA) and fish oil ($p < 0.001$). Characteristic cycles in groups during therapy comparing the anabolic steroid group are presented in Table 4. The obtained results are the health-destroying for cardiovascular and preventive outcome of the mutual interactions between the tested and control anabolic substances that circulate on the black market of the Balkans

Table 1. Characteristic Cycles in Groups Comparing Anabolic Steroids Group With Application of Statins, (ASK) And Fish Oil (Total 74 Male subjects, $p > 0.001$)

| | | |
|---|------------|--------------------|
| Cycles 6-9 Weeks | N/1 | 25 subjects |
| Methandrostenolone 25-50mg oral application | | 25 |
| Nandrolone Decanoate 300-400mg i.m | | 4 |
| Stanozolol 35 i 75 miligram / oral application | | 12 |
| Testosterone Cypionate 250-500mg 2-3ml per week i.m | | 2±1 |
| Trenbolone acetate 30-75mg oral | | 2 |
| Trenbolone acetate 10 mg i.m ever 2-3 day per week | | 23 |
| Cycles 6-9 Weeks | N/2 | 35 subjects |
| Methandrostenolone 25-50mg oral application | | 33 |
| Testosterone Propionate 250 – 500mg 2-3ml weekly i.m | | 29 |
| Testosterone Enanthate 250-300mg 1-2ml weekly i.m | | 19 ±1 |
| Oxymetholone 50 -100mg per day | | 6 |
| Cycles 6-9 Weeks | N/3 | 10 subjects |
| Methandrostenolone 25-50mg oral application | | 7 |
| Trenbolone acetate 75-100mg intramuscular application | | 3 ±1 |
| Sustanon /Sustan (250-300) intramuscular application | | 19±2 |
| Drostanolone propionate 300-400mg i.m | | 5 ±1 |
| Oxymetholone 50 -100mg per day | | 2±1 |
| Mesterolone/proviron 25-50 mg per day | | 5±1 |
| Cycles 6-9 Weeks | N/4 | 4 subjects |
| Sustanon 250 -400 1-3ml per week | | 4 |
| Testosterone Propionate 250 – 500mg 2-3ml weekly i.m | | 4 |
| Tamoxifen Citrate 10- 20mg (oral application) | | 3 |
| Anastrozol 0,5-1mg mg every day (oral application) | | 1 |

| Cycles 6-9 Weeks | N/1 | 25 subjects |
|--|------------------|-------------|
| Mesterolone/proviron | 25-50 mg per day | 3 |
| Average years of training experience in the gym | | 5,12±0,13 |
| Cleaning period before study in years under 6 months in year | | 27±1 |
| Cleaning period before study in years over 6 months in year | | 3±2 |
| Average Systolic blood pressure in groups (mmHg) | | 145.2 |
| Average Diastolic blood pressure in groups (mmHg) | | 84.7 |
| Average Triglycerids | 0,46-2,28 mmol/l | 1.55±0.02 |
| Average LDL low-density lipoprotein | 1,55-4,53mmol/l | 4.67±0.12 |
| Average HDL high-density lipoprotein | 1.03-1.55mmol/l | 1.04±0.02 |
| Average Total Cholesterol | < 5,5 mmol/l | 6.23±0.09 |

The study indicates that in the comparison group of 66 participants, 49±4, (p>0.001), recorded oral intake of Methandrostenolone 25-75 mg per day, which is statistically significant data that this is the most frequently represented anabolic steroid in cycles. The results of the study indicate a statistically significant presence of Methandrostenolone also known as Methandienone or Methandrostenolone / Dianabol, anabolic steroid that is the most prevalent in both, tested and the control group (p>0.001). Relatively cheap and very effective from the appearance of Olympic sports in the the former Soviet Union SSSR to pharmaceutical copies and faster production and marketing of the Balkan black market. Anabolic steroid associated with the most dangerous possible side effects, with large water retention, and accelerated muscle anabolic action, as well as severe damage to the liver, kidneys, and cardiovascular system. The judge also pointed out the impossibility of controlling LDL and HDL lipids with combinations of omega 3-6-9 supplements (fish Oil).

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Table 2. Characteristic Cycles in Groups Comparing Anabolic Steroids Group Without Application of Statins and (ASK), Fish Oil (Total Male 66 Subjects, p>0.001)

| Cycles 6-9 Weeks | R/1 | 15 subjects |
|---|-------------------------------------|-------------|
| Methandrostenolone | 25-50mg oral application | 21±4 |
| Nandrolone Decanoate | 300-400mg i.m | 2±1 |
| Stanozolol | 35 i 75 miligram / oral application | 2 |
| Testosterone Cypionate | 250mg 1-3ml per week i.m | 27±1 |
| Cycles 6-9 Weeks | R/2 | 31 subjects |
| Methandrostenolone | 25-50mg oral application | 22 |
| Testosterone Propionate | 250mg 2-3ml weekly i.m | 31 |
| Testosterone Enanthate | 250-300mg 1-2ml weekly i.m | 21 |
| Cycles 6-9 Weeks | R/3 | 6 subjects |
| Methandrostenolone | 25-50mg oral application | 4 |
| Trenbolone acetate | 75-100mg intramuscular application | 3 |
| Sustanon /Sustan (250-350) | intramuscular application | 9±2 |
| Drostanolone propionate | 300-400mg i.m | 5 ±1 |
| Cycles 6-9 Weeks | R/4 | 14 subjects |
| Methandrostenolone | 25-75mg oral application | 2 |
| Sustanon | 250 - 1,000mg per week | 2 |
| Testosterone Propionate | 250 – 500mg 2-3ml weekly i. m | 18 |
| Oxymetholone | 50 -100mg per day | 5±1 |
| Average years of training experience in the gym | | 5.12±0.13 |

| Cycles 6-9 Weeks | R/1 | 15 subjects |
|--|------------------|-------------|
| Cleaning period before study in years under 6 months in year | | 27±1 |
| Cleaning period before study in years over 6 months in year | | 3±2 |
| Average Systolic blood pressure in groups (mmHg) | | 143.7 |
| Average Diastolic blood pressure in groups (mmHg) | | 84.7 |
| Average Triglycerids | 0,46-2,28 mmol/l | 1.55±0.02 |
| Average LDL low-density lipoprotein | 1,55-4,53mmol/l | 2.67±0.12 |
| Average HDL high-density lipoprotein | 1.03-1.55mmol/l | 1.41±0.03 |
| Average Total Cholesterol | < 5,5 mmol/l | 5±2 |

The conducted study also indicates the insufficiency of the lipid protective therapy strategy in both tested groups (Table 3) after 6 months HDL (high-density lipoprotein) 0.84 ± 0.02 and 4.6 ± 0.03

which brings the study participants of the two groups into the risk population group who are at risk of cardiovascular disease to get futuristic heart attack or stroke ($p < 0.0001$).

Table 3. Characteristics Cycles in Groups During Therapy, Comparing Anabolic Steroids Group with and Without Application of Statins, (ASK) and Fish Oil ($p < 0.001$)

| Average HDL and LDL levels (after 1-6 months) | With Application of Statins, (ASK) and Fish Oil | Without Application of Satins (ASK), and Fish Oil |
|---|---|---|
| Average HDL after 1 month (mmol/l) | 1.01±0.02 | 1.07±0.02 |
| Average LDL after 1 month (mmol/l) | 4.5 ±0.02 | 4.3 ±0.02 |
| Average HDL after 2 month (mmol/l) | 0.90±0.02 | 0.90±0.03 |
| Average LDL after 2 month (mmol/l) | 4.4 ±0.03 | 3.9± 0.06 |
| Average HDL after 3 month (mmol/l) | 0.91±0.04 | 0.91±0.03 |
| Average LDL after 3 month (mmol/l) | 4.3 ±0.03 | 3.9 ±0.02 |
| Average HDL after 4 month (mmol/l) | 0.89±0.05 | 0.90±0.03 |
| Average LDL after 4 month (mmol/l) | 4.4 ±0.03 | 3.5 ±0.03 |
| Average HDL after 5 month mmol/l) | 0.88±0.02 | 0.89±0.04 |
| Average LDL after 5 month (mmol/l) | 4.5 ±0.03 | 3.4 ±0.03 |
| Average HDL after 6 month (mmol/l) | 0.84±0.02 | 0.84±0.02 |
| Average LDL after 6 month (mmol/l) | 4.6 ±0.03 | 3.2 ±0.03 |
| Average hematocrit HCT finding after 6months (L/L) normal 370-510 | 554±120 | 524±220 |
| Average platelet count (PLT) 140-450 x 109/l | 320±15 | 467±22 |

Table 4. Characteristic Cycles in Groups During Therapy Comparing Anabolic Steroids Group ($p < 0.0001$)

| | With application of Statins, (ASK) and Fish oil | Without application of Statins, (ASK) and Fish oil |
|--|---|--|
| Evidence of agresive behavior | 9 | 15±2 |
| Evidence of automutilation (Self-inflicted physical harm by cutting) | 1 | 2 |
| Evidence of committed crime / delinquent behaviour/ | 6±3 | 7 |
| Evidence of suacidal behavior or automutilation | 1 | 0 |
| Lack of self-control (misdemeanor) | 16±3 | 12±3 |

Statistically, from the context of the examined and control groups, we can say that improper, uncontrollable and irrational use of anabolic steroids for impractical sports purposes to achieve certain superior physical performances among the Balkan bodybuilding population drastically leads to a violation of the psychophysical state of the individual with a dramatic impact on the cardiovascular state of health. Black market Testosterone in the form of mix (Sustanon/Sustan/Testomix), Propionate, Enanthate

or Cypionate was statistically significantly the most represented as a base and potential base of other steroids in both tested groups (tested and control group), ($p < 0.0001$) Proviron and Novaldex were also represented in cycles with a statistically insignificant number in both groups ($p > 0.0001$) It probably has something to do with why they are not as frequently used in all groups as they are with different types of cycle.

It is interesting that the manifestation of aggression is a statistically significant (Table 4) data in both groups (examined group 9 subjects and control group 15 ± 2 subjects) ($p < 0.0001$) also, 13 ± 4 respondents of both groups showed a propensity for criminal acts (fights, violence against individuals, violation of public order and peace) statistically confirmed in both groups ($p < 0.0001$). The study data on self-mutilation were insignificant ($p > 0.0001$). Lack of self-control was significantly statistically confirmed in both groups ($p < 0.0001$). Both groups recorded a significant number of misdemeanor presents (examined group 16 ± 3 subjects and control group 12 ± 3) ($p < 0.0001$), which may indicate personality imbalance in different types of stacking. The statistical significance of the decrease in platelets was shown by the group (Table 3) that received acetylsalicylic acid and statins (320 ± 15), in contrast to the control group, which had a high increase in platelets from (467 ± 22) ($p < 0.0001$).

Discussion

The data in the study point to the imminent danger of the irrational consumption of black market anabolic steroids in the Balkans, as well as the imminent danger of their application itself. The biggest stimulus to scientific medical interest is the constant increase in the epidemiology of nutritional imbalance with the rise in hyperlipidemia. It is directly correlated with cardiovascular symptomatology, arterial hypertension, and the onset of type II diabetes as well as cardiovascular incidents in the younger population, at risk ages 18 to 35, and even below 18-year-olds who regularly abuse anabolic steroids²⁻⁸. Although many studies of anabolic steroids have focused predominantly on the onset of aggression towards others as well as criminal, asocial, delinquent behaviour, even suicidal behaviour, the scientific facts about automation in the misuse of consumption of anabolic preparations are poorly known²⁰⁻²⁸.

The pathological process of early threatening cardiovascular association between anabolic steroid consumption, cholesterol levels rise and HDL decline, as well as high and low-density lipoprotein imbalance (LDL-HDL ratio) induces a clearly threatening effect on arterial endothelial destruction with disruption of physiology of hemodynamic system. In this way, pathological degeneration of blood structures on all vascular systems is accelerated with a prediction to coronary

arteries. Already in the last decade, the focus of scientific medical publicity is the rise in cardiovascular incidents caused by supra-therapeutic doses of anabolic steroids in a growing population, with no clear record of the periods, cycles, doses and stacking of anabolic steroid abuse. Although the cessation of pseudo-sports commercialization cannot be affected, epidemics of abuse of anabolic steroids stacking, potential primary and secondary cardio-protection options with adequate medications and doses are slowly emerging from the shadows and have become a topic of considerable scientific debate^{2,3,4,8,24,25}. Statins or HMG-KoA reductase inhibitors are the most commonly prescribed, with clinically independent and variable doses of 10-80mg, and used in the treatment of primarily elevated serum lipids and they play an important role in primary and secondary cardio-protection. Statins (atorvastatin and simvastatin) competitively and reversibly block HMG-CoA reductase, an enzyme that reduces 3-hydroxy-3-methylglutaryl coenzyme in the liver. Although statins block the synthesis of cholesterol, which is needed for the further metabolism of testosterone synthesis and further testosterone derivatives such as DHT, the benefits of consuming statins, unsaturated fatty acids and acetylsalicylic acid in combination with an adequately adjusted diet would be beneficial. Moreover, an elevated lipid impact factor caused by enormously stacking with anabolic steroids is in direct correlation with increasing and serious cardiovascular incidents even after decades of professional use. Not only do they pose a risk of misuse of sports, but they are also increasingly within reach of the younger sports and recreational Balkan bodybuilding population. Although a number of scientific studies have shown significant progression of atherosclerosis in young users of anabolic steroids, as well as the treatment of hyper lipoproteinemia, which is a regular occurrence in users, satisfactory results are not obtained with dietary measures or only with high doses of polyunsaturated fatty acid supplementation. As a result, cardio-protection therapy remains in the shadows without adequate guidance on avoiding potential conservative or invasive and/or minimally invasive surgical precedents²⁶. Although testosterone deficiency is known in diabetics and vascular chronic patients who suffer from claudication problems, in the case of excessive and irrational consumption of anabolic steroids in the younger population group, it can cause a severe chronic course of the disease and even death.

Also, aneurysmal diseases of the aorta can have a potential connection with the irrational application of anabolics, also a scientific field poorly researched in our Balkan country 1,4,5 In the United States, a number of studies have been conducted on the misuse of anabolic steroids in the younger population (high school and college) with the goal of fulfilling a sports career during school. Studies have shown an initial application of age-related steroids between schoolchildren who are 12 to 18 years of age with astonishing results of 1.4% to 12% in the male (with a third of average of 17 years of age) and in the female population of 0.5% to 2.9%. which is also alarming and does not exclude an increased risk of accelerating the pathological process of atherosclerosis and consequent cardiovascular diseases and the decline of the age decade in cardiovascular incidents, as well as the possibility of sudden death or maybe involvement in criminal or family violence²⁷⁻³⁰. Assuming that these are two different motivational groups (high school motivation through scholarship, competition motivation and sporting success), the statistics of the epidemic tendency of the Balkan young recreational population without the motivation and competence of the application could potentially go unnoticed and outweigh the more frequent cardiovascular incidents. But it could be worse than the statistics of young respondents from the USA. Based on other data on the combination of anabolic steroids that cause cardiovascular incidents we could only speculate, and would require additional studies to streamline and objectify socio-medical data related to the irrational consumption of anabolic steroids in the young recreational bodybuilding population. Studies have shown statistically more adequate results of raising HDL with simvastatin than with atorvastatin in secondary and primary prevention of atherosclerosis in patients over 50 years of age, as well as the significant benefits of reducing HDL seen in the younger population. In addition to changes in serum lipids, the benefits of simvastatin are also significant after one year of initiation of therapy. Thus, by administration alone, recreational users who stack anabolic steroids would have the potential double benefit of using simvastatin and the doses of semi-saturated fatty acids Omega 3-6-9³¹⁻³⁴.

Therapeutically overdosed use of anabolic steroids aims at accelerating athletic performance and increased myohypertrophy, thus affecting a range of disorders that indicate serious cardiovascular

disorders. Smaller therapeutic doses for short periods are relatively safe and have their potential application for medical alternative purposes. Therapeutically overdosed abuse of anabolic steroids has the effect of reducing HDL, increasing LDL, and causing disruption of high and low density lipids (HDL and LDL) leading to the onset of atheromatosis with progression of thrombocyte adhesion and acceleration of the pathology of atherosclerosis itself. Benefits of Methandrostenolone in medical therapeutic doses have the effect of reducing triglycerides in normal individuals, as well as reducing total cholesterol with lowering cholesterol concentrations in patients, and contributing to increased plasma post-heparin lipolytic activity. Considering the potential treatment potential, a significant increase in LDL and a decrease in HDL with poor results have been reported in patients with borderline triglyceride and serum lipid levels³⁵⁻³⁸. Studies of the medical applications of Stanozolol and the Nandrolone ester have scientifically significantly resulted in inadequate administration of serum lipid level deletion, and that long-term abuse of supra-therapeutic doses of such substances carries a high-risk threatening potential for a cardiovascular incident^{36,39}.

Medical therapeutic intramuscular applications of the prohormone androsterone 3-Alpha-Hydroxyetioallocholan-17-metabolite testosterone and dihydrotestosterone (DHT) in the Hellman and Cohen studies result in a fall in LDL and total cholesterol, phospholipids and triglycerides, while in oral applications it leads to a significant increase occurs in lipids in the serum, as well as individual HDL decline in the subjects. Although younger generations do recreational bodybuilding, doses of 300-400mg/day are rarely used, 4-8 weeks with the individual benefits of losing fat and speeding up metabolism without conversion to oestrogen, synthetic testosterone of various ester variants is more prevalent^{40, 41}. Oxandrolone, as one of the most scientifically studied anabolic steroids in the early 1970s, and potentially the safest steroid, resulted in triglyceride and cholesterol drops in normal subjects and was highly effective at therapeutic doses in reducing plasma lipids. The benefits of deletion of triglycerides over other anabolic steroids at therapeutic doses are significant. The study by the German authors⁴², does not exclude the presence of potential hidden doping that can be a trigger for pathological changes in venous circulation. Unlike arterial

diseases, venous pathology disorders are related to sports and the place of origin it differs depending on the type of sports activity. Accompanying factors have a local difference which means that it does not exclude the potential consumption of doping substances of underground pharmacology. In addition to the imminent cardiovascular incident and other damages in this scientific study, the author⁴³ connects the abuse of anabolic steroids of different spectrum of metabolic effect, connects the violation of the personality structure with the presence of anxiety and other mental pathology.

Oxandrolone was also orally consumed frequently in the study. The mechanism of effects of oxandrolone on lipids has not been fully elucidated, and is thought to inhibit excess triglyceride synthesis, although the supra-therapeutic properties suggest in contrast the specific imbalance of HDL and LDL and the reduction of HDL. Studies with testosterone cypionate showed a greater decrease of 21% at doses of 300mg per week, while other studies showed different comparisons of the deletion of HDL at doses of 6mg stanozol per day and 200mg of testosterone ethane per week, resulting in a fall in HDL and HDL cholesterol by 33% and 71%. Testosterone ethane in combination with aromatase inhibitors recorded a decrease in HDL only after 12 weeks by 25% with an increase in LDL and total cholesterol⁴⁴⁻⁴⁷. Because optimal results with oral acetylsalicylic acid are achieved at doses of 40mg to 160mg daily, the benefits of daily doses of 150mg (2x75mg) every 12 hours give an optimizing effect in patients with cardiac symptomatology in primary cardio-protection as well as in patients with peripheral artery stage II disease in claudication symptomatology. In this way, patients would also have use in secondary cardio-protection and in all vascular systems, because the reaction of acetylation, irreversible inactivation of COX-1 that cannot be restored in platelets, and due to the reduction of thromboxane A2 synthesis, the anti-aggregation effect and inhibition of the cyclo oxygenase enzyme occurs. With such measures, young recreational athletes with the additional consumption of high doses of semi-saturated fatty acids and Simvastatin would have the potential benefits of primary and secondary cardio-protection. However, further studies are required by more subjects to prove such a scientific claim⁴⁸⁻⁵³.

For many young bodybuilding recreational athletes on the on the essential list during cycles, due to their

high fat content, the consumption of semi-saturated fatty acids is subjectively avoided as a cardiovascular protective strategy during steroid cycles. This is especially evident in those recreational users who consume oral administration of anabolic steroids. With oral administration of C17 alpha alkaline (C17-alpha alkylated) such as Oxymetholone, Stanozolol and Methandrostenolone, as well as high doses of intramuscular weekly use of Sustanone (over 1500mg weekly), which are still under scientific investigation, we have noticed a destructive effect on the cardiovascular system, such as and liver function by elevating liver enzymes alanine transaminase (ALT) and aspartate transaminase (AST) by safely accelerating endothelial destruction and changes in lipid status, with imbalance of lipoprotein, LDL (low-density lipoprotein) and HDL (high-density lipoprotein) with increasing total cholesterol and triglycerides. Also, the strategy of implementing high doses of polyunsaturated fatty acids, 10g and 20mg of Simvastatin and 150 mg of acetylsalicylic acid would make the cardio-protective concept incomplete or minimal during anabolic cycles in young users of anabolic steroids without excluding acetyl salicylic acid and consuming semi-saturated fatty acids and periods further training process. Therefore, the cardio-protective measures and guidelines of the young recreational bodybuilding population which is abusing anabolic steroids would be potentially more effective⁵⁴⁻⁶².

Anti-inflammatory benefits of high doses of fish oil supplementation as well as substances (DHA C22: 6 Docosahexaenoic acid and EPA C20: 5 eicosapentaenoic acid) are known by post-adaptive regenerative process of nerve structures and damaged tissue caused by physical activity, and they contribute as an important factor in the skeletal muscle regeneration and post-ischemic phase of cardiac muscle with left ventricular remodelling in the post-infarction phase. It plays an important role in the direct blocking of fibroblast transformation and collagen synthesis through the activation of GMP/protein kinase. Also, in primary effects of the pathohistological destruction of the cardiovascular system caused by anabolic steroids of enormous and irrational doses in young athletes, the benefits of high doses of fish oil in cardio-protection would be prospective because of the individual symptomatology of unpredictable individual impingement on the cardiovascular system⁶³⁻⁷¹. The study by Kařka et al. (2007)²²

produced significant results after 6 months of simvastatin administration in patients with chronic cardiac ischemic disease at the level of HDL improvement regardless of the level of exercise load of programmed individual physical activity, and cardio lipo-protective therapy showed more than expected, while recreational anabolic steroids would have no significant effect on HDL levels alone due to the effects of anabolic steroids. From our team point of view, triple cardio-protective therapy with anabolic steroids at supra-therapeutic doses would have weak and partial individual sense with a somewhat effective effect on LDL levels with the destruction of the cardiovascular system by stacking anabolic steroids of questionable and individual quality that has not been thoroughly examined yet. Although generally speaking of anabolic steroids, Trenbolone Acetate has the most potential for social and mental health impairment in the Balkan population of recreational bodybuilding.

Also, a number of specific studies related to this substance are needed to statistically confirm the cause of health damage. and the question arises as to how many lives this underestimated epidemic will harm and take away¹⁻⁵. We professionally believe that psychological support is needed in the form of stopping the consumption of anabolic steroids as well as additional measures to protect this young population group before the appearance of chronic cardiovascular symptoms as well as an incurable impairment of the mental state of consciousness. The problem of the black, underground pharmacology of illegal doping substances is specific because physicians do not have adequate insight into the consumption of anabolic steroids, nor insight into the quality of certain substances, which makes this problem extremely multidisciplinary and medically complex in our country²⁻⁴. We conclude that this individual irrational use of anabolic steroids in order to achieve rapid physical performance directly affects the psychological destruction of consciousness as the accelerated development of atherosclerosis in all possible segments with permanent damage to general health.

Conclusion and further research

Self-initiated consumption of some anabolic steroids conceived on video media in the Balkan black market has a devastating cardiovascular and social potential for the young population. The most common information is mostly obtained through social media without adequate and limited medical guidelines that are based on studies of the last century in other countries or states that have politically disintegrated, and more recent researchers are needed related to the Balkan population of the young bodybuilding population. As different stacking methods of the questionable quality products from the black market for anabolic steroids with supra-therapeutic doses in young recreational bodybuilders of the ages of 17 to 30 accelerates the pathology of atherosclerosis without a scientifically statistical prognosis of unknown scale, elevated LDL levels have already been observed in all decade-long users of anabolic steroids and risky HDL levels have been recorded, as well as an arterial pre-hypertension condition. A preventative cardio-protective strategy of acetylsalicylic acid, polyunsaturated fatty acids and simvastatin would make little or partial sense with adequate physician supervision, as well as insight into the abstinence of supra-therapeutic administration of individual and/or combined anabolic steroids, as well as the design substances of the testosterone variations of the functional esters of the synthetic testosterone groups primary cardiovascular risk, and acceleration of the atherosclerotic cascade pathophysiological process. Effect of statins on strength and desired subjective strength result during stacking of anabolic steroids in the recovery cycle of the young recreational bodybuilding population remains a largely unexplored area of potential cardiovascular damage with the progression of irrational anabolic steroid abuse day by day. We can say that cardio-protection would be more effective in abstinence of abusing of the anabolic steroids.

Conflict of interest

The authors declare no conflict of interest

References

1. Solakovic S, Vrcic M, Pavlovic R, et al. Irrational Abuse of Testosterone and Mass Supplements by Recreational Bodybuilders with “Adonis Complex” Leads to Potential Cardiovascular Diseases and Psychophysical Disorders *International Journal of Sports Science*. 2016; 6(6): 230-236
2. Solakovic S, Vrcic M, Pavlovic R, et al. HDL Level In Amateur Bodybuilders Who Misuse The Combination Of Testosterone Products And Anabolic Steroids In Bosnia And Herzegovina. *Slovak Journal of Sport Science*. 2016; 1 (1): 2- 8
3. Solakovic S, Vrcic M, Pavlovic R, et al. Potential Cardiovascular Side Effects Of Trenbolone Acetate Steroid Stacking In Young Section A-Research paper Recreational Bodybuilders Compared With Another Potential Cardiovascular Side Effects Of Anabolic Steroids And What Is Thoroughly Hiding Behind Trenbolone Acetate Roid Rage Myth? *European Chemical Bulletin*. 2022; 11(11):64-72. DOI:10.31838/ecb/2022.11.11.007
4. Solakovic S, et al. Hidden Danger of Irrational Abusing Illegal Androgenic-anabolic Steroids. *Med Arh*. 2015; 69 (3): 200-202. doi: 10.5455/medarh.2015.69.200-202
5. Solaković S, Vrcić M, Pavlović R. Does Obsession Of Irrational Stacking Anabolic Steroids With Trenbolone Acetate Over Decades Leads To General, Cardiovascular Or Social Deviation Problem In Young Adults, Or Just Biggest Muscle Mass Is Equal Highest Social Reputation In Gym And Is This All Price Health Worth? - Case Report. *European Journal Of Physical Education And Sport Science*. 2019; 5 (7): 54-63. doi.org/10.5281.
6. Stergiopoulos K, Brennan JJ, Mathews R, Setaro JF, Kort S. Anabolic steroids, acute myocardial infarction and polycythemia: a case report and review of the literature. *Vasc Health Risk Manag*. 2008;4(6):1475-80. doi: 10.2147/vhrm.s4261.
7. Güneş Y, Erbaş C, Okuyan E. Myocardial infarction with intracoronary thrombus induced by anabolic steroids. *Anadolu Kardiyol Derg*. 2004; 4 (4): 357–358.
8. Halvorsen S, Thorsby PM, Haug E. Akutt hjerteinfarkt hos ung mann som brukte androgene anabole steroider [Acute myocardial infarction in a young man who had been using androgenic anabolic steroids]. *Tidsskr Nor Lægeforen*. 2004;124 (2):170-2. Norwegian. PMID: 14743229.
9. Büttner A, Sachs H, Mall G, . Progressive idiopathic bilateral striato-pallido-dentate calcinosis (Fahr’s disease) in a person with anabolic steroid abuse. *Leg Med (Tokyo)* 2001; 3: 114–118.
10. Tischer KH, Heyny-von Haussen R, Mall G. Coronary thrombosis and ectasia of coronary arteries after long-term use of anabolic steroids. *Z Kardiol*. 2003; 92 (4): 326–331. doi: 10.1007/s00392-003-0915-6.
11. Kokkonen L, Anttonen O, Penttilä O. Protein C deficiency and use of anabolic steroids behind the myocardial infarction in a young man. *Duodecim*. 2001; 117 (22): 2279–2281. Finnish.
12. Fineschi V, Baroldi G, Monciotti F. Anabolic steroid abuse and cardiac sudden death: A pathologic study. *Arch Pathol Lab Med*. 2001; 125 (2): 253–255. doi: 10.5858/2001-125-0253-ASAACS
13. Godon P, Bonnefoy E, Guérard S. Myocardial infarction and anabolic steroid use. A case report. *Arch Mal Coeur Vaiss*. 2000; 93 (7): 879–883. French.
14. Sever PS, Poulter NR, Dahlof B, Wedel H, Beevers G, Caulfield M, Collins R, Kjeldsen SE, Kristinsson A, McInnes G, Mehlsen J, Nieminen MS, O'Brien ET, Ostergren J; ASCOT Investigators. The Anglo-Scandinavian Cardiac Outcomes Trial lipid lowering arm: extended observations 2 years after trial closure. *Eur Heart J*. 2008; 29(4):499-508. doi: 10.1093/eurheartj/ehm583.
15. Sever PS, Dahlof B, Poulter NR, et al. for the ASCOT investigators. Prevention of coronary and stroke events with atorvastatin in hypertensive patients who have average or lower-than-average cholesterol concentrations, in the Anglo-Scandinavian Cardiac Outcomes Trial – Lipid Lowering Arm (ASCOT-LLA): a multicentre randomized controlled trial. *Lancet*. 2003; 361(9364):1149-1158. doi: 10.1016/S0140-6736(03)12948-0.
16. Golomb BA, Dimsdale JE, White HL, Ritchie JB, Criqui MH. Reduction in blood pressure with statins: results from the UCSD Statin Study, a randomized trial. *Arch Intern Med*. 2008; 168(7):721-7. doi: 10.1001/archinte.168.7.721.

17. Kersey RD, Elliot DL, Goldberg L, Kanayama G, Leone JE, Pavlovich M, Pope HG Jr; National Athletic Trainers' Association. National Athletic Trainers' Association position statement: anabolic-androgenic steroids. *J Athl Train.* 2012; 47(5):567-88. doi: 10.4085/1062-6050-47.5.08.
18. Bahrke MS, Yesalis CE. Abuse of anabolic androgenic steroids and related substances in sport and exercise. *Curr Opin Pharmacol.* 2004; 4 (6): 614–620. doi: 10.1016/j.coph.2004.05.006
19. Fineschi V, Riezzo I, Centini F. Sudden cardiac death during anabolic steroid abuse: Morphologic and toxicologic findings in two fatal cases of bodybuilders. *Int J Legal Med.* 2007; 121(1): 48–53. doi: 10.1007/s00414-005-0055-9.
20. García-Esperón C, Hervás-García JV, Jiménez-González M, Pérez de la Ossa-Herrero N, Gomis-Cortina M, Dorado-Bouix L, López-Cancio Martínez E, Castaño-Duque CH, Millán-Torné M, Dávalos A. Ingesta de esteroides anabolizantes e ictus isquémico. Presentación de un caso clínico y revisión de la bibliografía [Ingestion of anabolic steroids and ischaemic stroke. A clinical case report and review of the literature]. *Rev Neurol.* 2013; 56(6):327-31. Spanish.
21. Solberg EE, Borjesson M, Sharma S, Papadakis M, Wilhelm M, Drezner JA, Harmon KG, Alonso JM, Heidebuchel H, Dugmore D, Panhuyzen-Goedkoop NM, Mellwig KP, Carre F, Rasmussen H, Niebauer J, Behr ER, Thiene G, Sheppard MN, Basso C, Corrado D; Sport Cardiology Section of the EACPR of the ESC. Sudden cardiac arrest in sports - need for uniform registration: A Position Paper from the Sport Cardiology Section of the European Association for Cardiovascular Prevention and Rehabilitation. *Eur J Prev Cardiol.* 2016;23(6):657-67. doi: 10.1177/2047487315599891.
22. Kałka D, Sobieszkańska M, Kopka L, Marciniak W, Zawadzka-Bartczak E, Bak A, Popielewicz-Kautz A, Korzeniowska J, Janczak J, Adamus J. Wpływ długotrwałego treningu kardiologicznego na stężenie lipidów u chorych z przewlekłą chorobą niedokrwienną serca leczonych simwastatyna [Effect of long-term cardiac training on lipids concentration in patients with chronic heart ischemic disease treated with simvastatin]. *Pol Merkur Lekarski.* 2007;22(128):101-6. Polish..
23. Petersson A, Bengtsson J, Voltaire-Carlsson A, Thiblin I. Substance abusers' motives for using anabolic androgenic steroids. *Drug Alcohol Depend.* 2010;111(1-2):170-2. doi: 10.1016/j.drugalcdep.2010.04.008.
24. Choi PY, Pope HG Jr. Violence toward women and illicit androgenic-anabolic steroid use. *Ann Clin Psychiatry.* 1994;6(1):21-5. doi: 10.3109/10401239409148835.
25. McKillop G, Todd IC, Ballantyne D. Increased left ventricular mass in a bodybuilder using anabolic steroids. *Brit J Sports Med.* 1986; 20 (4):151–152. doi: 10.1136/bjism.20.4.151
26. McNutt RA, Ferenchick GS, Kirlin PC, et al. Acute myocardial infarction in a 22-year old world class weight lifter using anabolic steroids. *Am J Cardiol.* 1988; 62 (1):164. doi: 10.1016/0002-9149(88)91390-2.
27. McQueen MJ, Hawken S, Wang X, Ounpuu S, Sniderman A, Probstfield J, Steyn K, Sanderson JE, Hasani M, Volkova E, Kazmi K, Yusuf S; INTERHEART study investigators. Lipids, lipoproteins, and apolipoproteins as risk markers of myocardial infarction in 52 countries (the INTERHEART study): a case-control study. *Lancet.* 2008;372(9634):224-33. doi: 10.1016/S0140-6736(08)61076-4.
28. Buckley WE, Yesalis CE 3rd, Friedl KE, Anderson WA, Streit AL, Wright JE. Estimated prevalence of anabolic steroid use among male high school seniors. *JAMA.* 1988;260(23):3441-5. PMID: 3210283.
29. Bahrke MS, Kennedy NJ, Kopstein AN & Yesalis CE. Anabolic-androgenic steroid use in the United States. *JAMA.* 1993; 270 (10): 1217-1221.
30. Windsor R, Dumitru D. Prevalence of anabolic steroid use by male and female adolescents. *Med Sci Sports Exerc.* 1989;21(5): 494-497.
31. Komoroski EM, Rickert VI. Adolescent body image and attitudes to anabolic steroid use. *Am J Dis Child.* 1992;146(7):823-8. doi: 10.1001/archpedi.1992.02160190055019.
32. Boden WE. High-density lipoprotein cholesterol as an independent risk factor in cardiovascular disease: assessing the data from Framingham to the Veterans Affairs High-Density Lipoprotein Intervention Trial. *Am J Cardiol.* 2000;86(12A):19L-22L. doi: 10.1016/s0002-9149(00)01464-8.
33. Branchi A, Fiorenza AM, Torri A, Muzio F, Berra C, Colombo E, Dalla Valle E, Rovellini A, Sommariva D. Effects of low doses of simvastatin and atorvastatin on high-density

- lipoprotein cholesterol levels in patients with hypercholesterolemia. *Clin Ther.* 2001;23(6):851-7. doi: 10.1016/s0149-2918(01)80073-4.
34. Branchi A, Fiorenza AM, Torri A, Berra C, Colombo E, Rovellini A, Sommariva D. Effects of simvastatin on blood pressure in hypercholesterolemic patients: An open-label study in patients with hypertension or normotension. *Curr Ther Res Clin Exp.* 2004;65(3):239-54. doi: 10.1016/S0011-393X(04)80057-2.
35. Heart Protection Study Collaborative Group MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20, 536 high-risk individuals: A randomised placebo-controlled trial. *Lancet.* 2002;360 (9326):7–22.
36. Skinantia SG, Jaya Rao KS et al. Effects of aC-17 alkylated steroid, methylandrostenolone, on plasma lipids of normal subjects. *Amer.J.Med.Sci* 1967; 254 (2):201-204. doi: 10.1097/00000441-196708000-00010.
37. Kuo PT, Quick RE et al. Improvement of hypertriglyceridemia by anabolic agent in primary type of hyperlipoproteinemia. *Circulation.* 1970; (3):18.
38. Jose AD, Mitchell AS. Elevation of serum cholesterol by anabolic steroids. *Lancet.* 1964; 1 (7331): 473-474. doi: 10.1016/s0140-6736(64)90802-5
39. Jungck EC, Greenblatt RB et al. Methandrostenolone an oral anabolic agent. *Sth.med.J.* 1964; 57:909-913. doi: 10.1097/00007611-196408000-00008
40. Furman RH et al. Idiopathic hyperglyceridaemia treated with methyltestosterone and methandienone. *Lancet.* 1963; 1(7285):837. doi: 10.1016/s0140-6736(63)91553-8
41. Simons RG, & Grinwich DL. Immunoreactive detection of four mammalian steroids in plants. *Canadian Journal of Botany.* 1989; 67 (2): 288-296. DOI:10.1139/b89-042
42. Hilberg T, Ransmann P, Hagedorn T: Sport and venous thromboembolism—site, accompanying features, symptoms, and diagnosis. *Dtsch Arztebl Int.* 2021; 118: 181–7. DOI: 10.3238/arztebl.m2021.002.
43. Piacentino D, Kotzalidis GD, del Casale A. et al. Anabolic-androgenic Steroid use and Psychopathology in Athletes. *A Systematic Review Current Neuropsychology.* 2015; 13 (1): 101-121. doi: 10.2174/1570159X13666141210222725.
44. Metcalf MG. The excretion of androsterone and etiocholanolone as a function of adrenocortical and gonadal activity. *Clinical Biochemistry.* 1972; 5(1): 19-32. doi: 10.1016/s0009-9120(72)80005-5
45. Bolding G, Sherr L, Elford J. Use of anabolic steroids and associated health risks among gay men attending London gyms. *Addiction.* 2002;97(2):195-203. doi: 10.1046/j.1360-0443.2002.00031.x.
46. Scott M. Grundy, Gloria L. Vega, James D. Otvos, David L. Rainwater, Jonathan C. Cohen,
47. Hepatic lipase activity influences high density lipoprotein subclass distribution in normotriglyceridemic men: genetic and pharmacological evidence. *Journal of Lipid Research.* 1999; 40 (2):229-234. /doi.org/10.1016/S0022-2275(20)33361-7.
48. Kouri EM, Pope HG Jr, Oliva PS. Changes in lipoprotein-lipid levels in normal men following administration of increasing doses of testosterone cypionate. *Clin J Sport Med.* 1996; 6(3):152-7. doi: 10.1097/00042752-199607000-00003.
49. Friedl KE, Hannan CJ Jr, Jones RE, Plymate SR. High-density lipoprotein cholesterol is not decreased if an aromatizable androgen is administered. *Metabolism.* 1990;39(1):69-74. doi: 10.1016/0026-0495(90)90150-b.
50. Nadar S, Lip G. Hypertension. 2. Oxford Cardiology Library; 2015.
51. Nansseu JR, Noubiap JJ. Aspirin for primary prevention of cardiovascular disease. *Thromb J.* 2015;13:38. doi: 10.1186/s12959-015-0068-7
52. Bochner F, Lloyd JV. Aspirin for myocardial infarction. Clinical pharmacokinetic considerations. *Clin Pharmacokinet.* 1995;28(6):433-8. doi: 10.2165/00003088-199528060-000018.
53. Berger JS, Lala A, Krantz MJ, Baker GS, Hiatt WR. Aspirin for the prevention of cardiovascular events in patients without clinical cardiovascular disease: a meta-analysis of randomized trials. *Am Heart J.* 2011;162:115.e112–24.e112.
54. Vandvik PO, Lincoff AM, Gore JM, Gutterman DD, Sonnenberg FA, Alonso-Coello P, et al. Primary and secondary prevention of cardiovascular disease: antithrombotic therapy and prevention of thrombosis, 9th ed: American

- College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2012;141:e637S–68.
55. Solakovic S, et al. Can the Irregular Acetylsalicylic acid (ASA) Therapy combined with Interval Training Exercise Program Increase the Claudication Distance in Diabetic and Non-diabetic Patients with Femoropopliteal Stenosis Age over 55. *European Journal of Physical Education and Sport Science*. 2017; 3(2):19-32. doi: 10.5281/zenodo.375659.
56. Kamleh MA, McLeod O, Checa A, Baldassarre D, Veglia F, Gertow K, Humphries SE, Rauramaa R, de Faire U, Smit AJ, Giral P, Kurl S, Mannarino E, Tremoli E, Silveira A, Örvik J, Hamsten A, Wheelock CE. Increased Levels of Circulating Fatty Acids Are Associated with Protective Effects against Future Cardiovascular Events in Nondiabetics. *J Proteome Res*. 2018; 17 (2):870-878. doi: 10.1021/acs.jproteome.7b00671
57. de Oliveira Otto MC et al. Circulating and dietary omega-3 and omega-6 polyunsaturated fatty acids and incidence of CVD in the Multi-Ethnic Study of Atherosclerosis. *J Am Heart Assoc*. 2013; 2(6):e000506. doi: 10.1161/JAHA.113.000506.
58. Mozaffarian D, Rimm EB. Fish intake, contaminants, and human health: evaluating the risks and the benefits. *JAMA*. 2006;296(15):1885-99. doi: 10.1001/jama.296.15.1885. Erratum in: *JAMA*. 2007 Feb 14;297(6):590.
59. Mozaffarian D, Micha R, Wallace S. Effects on coronary heart disease of increasing polyunsaturated fat in place of saturated fat: a systematic review and meta-analysis of randomized controlled trials. *PLoS Med*. 2010; 7:e1000252
60. Rizos EC, Ntzani EE, Bika E, Kostapanos MS, Elisaf MS. Association between omega-3 fatty acid supplementation and risk of major cardiovascular disease events: a systematic review and meta-analysis. *JAMA*. 2012;308(10):1024-33. doi: 10.1001/2012.jama.11374.
61. Wang C, Harris WS, Chung M, Lichtenstein AH, Balk EM, Kupelnick B, Jordan HS, Lau J. n-3 Fatty acids from fish or fish-oil supplements, but not alpha-linolenic acid, benefit cardiovascular disease outcomes in primary- and secondary-prevention studies: a systematic review. *Am J Clin Nutr*. 2006;84(1):5-17. doi: 10.1093/ajcn/84.1.5
62. Nettleton JA, Steffen LM, Mayer-Davis EJ, Jenny NS, Jiang R, Herrington DM, Jacobs DR, Jr Dietary patterns are associated with biochemical markers of inflammation and endothelial activation in the multi-ethnic study of atherosclerosis (MESA). *Am J Clin Nutr*. 2006; 83 (6):1369-137. doi: 10.1093/ajcn/83.6.1369.
63. Lemaitre RN, King IB, Mozaffarian D, Kuller LH, Tracy RP, Siscovick DS. n-3 Polyunsaturated fatty acids, fatal ischemic heart disease, and nonfatal myocardial infarction in older adults: the Cardiovascular Health Study. *Am J Clin Nutr*. 2003;77(2):319-25. doi: 10.1093/ajcn/77.2.319.
64. Heydari B, Abdullah S, Pottala JV, Shah R, Abbasi S, Mandry D, Francis SA, Lumish H, Ghoshhajra BB, Hoffmann U, Appelbaum E, Feng JH, Blankstein R, Steigner M, McConnell JP, Harris W, Antman EM, Jerosch-Herold M, Kwong RY. Effect of Omega-3 Acid Ethyl Esters on Left Ventricular Remodeling After Acute Myocardial Infarction: The OMEGA-REMODEL Randomized Clinical Trial. *Circulation*. 2016;134(5):378-91. doi: 10.1161/CIRCULATIONAHA.115.019949.
65. Drobnic F, Rueda F, Pons V, Banquells M, Cordobilla B, Domingo JC. Erythrocyte Omega-3 Fatty Acid Content in Elite Athletes in Response to Omega-3 Supplementation: A Dose-Response Pilot Study. *J Lipids*. 2017;2017:1472719. doi: 10.1155/2017/1472719.
66. Solakovic S, Vrcic M, Pavlovic R et al. Whether exercises and testosterone replacement therapy support a treatment for cardiovascular and atherosclerotic patients with iliac artery stenosis and low total testosterone and high-density lipoprotein cholesterol after endovascular procedure? *Zaporozhye medical journal*. 2023; 25 (2):101-108. doi.org/10.14739/2310-1210.2023.2.268513
67. Solaković S, Spahović H, Pavlović R, Jogunčić A, Solaković N, Vrcić M, Hajrulahović F. Connection of Low Serum Testosterone Levels in Cardiovascular Disease in Metabolic Syndrome Patients with Diagnosis of Critic Iliac Artery Stenosis (TASC II A and B) and Can Exercise Improve those Levels and Primary Potency of Revascularization after Surgical and

- Endovascular Treatment? (Pilot Study). *Saudi J Med.* 2023; 8(1): 8-17. DOI: 10.36348/sjm.2023.v08i01.002
68. Solakovic S, Vrcic M, Pavlovic R, et al. Effects of moderate-intensity continuous training therapy on claudication symptoms and carotid intima-media thickness in patients after endovascular and classical bypass treatment (a pilot study). *Zaporozhye medical journal.* 2020; 22 (6): 775-78. doi.org/10.14739/2310-1210.2020.6.218439
69. Solakovic S, Vrcic M, Pavlovic R et al. Vascular Rehabilitation Benefits of Tribulus Terrestris (TT), Taurine and High Dose Alpha Lipoic Acid (ALA) Supplementation with Interval Walking Training Program after Surgical Vascular Bypass Treatment (Pilot Study). *International Journal of Kinesiology and Sports Science.* 2019; 7 (3):22-33.
DOI: <https://doi.org/10.7575/aiac.ijkss.v.7n.3p.22>
70. Solakovic S, Vrcic M, Pavlovic R et al. Can Self-controlled Stationary Bicycle Moderate Intensity Training Increase Claudication Distance in Patients with Fontains Stage IIa without the Effects of Expansion on Infrarenal Abdominal Aortic Aneurysm (IAAA) Diameter without Iliac Artery Dilatation (IAD) and Iliac Artery Aneurysms (IAA)? *International journal of Exercise Physiology.* 2019; 8 (3.1): 180-190.
71. Solakovic S, Vrcic M, Pavlovic R et al. Irrational Abuse of Anabolic Steroids Stacking with Aromatase Inhibitors Increase Carotid Intima-Media Thickness (CIMT) and Lowering High Density Lipoprotein (HDL) levels Causing High Risk Factors for Cardiovascular Disease and Potential Steatohepatitis in Young Recreational Bodybuilders Age 17-30 (pilot study). *International journal of Exercise Physiology.* 2019;8 (3.1): 197-207.