Research Article

# High Density Lipoproteins May Actually be Some Negative Acute Phase Proteins in the Plasma

**Helvaci MR[1*], Aydin Y[1], Abyad A[2], and Pocock L[3]**

[1]Department of Gastroenterology and Hepatology, Medical Faculty of the Mustafa Kemal University, Serinyol, Antakya, Hatay, Turkey

Received Date: 12 Nov 2019
Accepted Date: 12 Dec 2019
Published Date: 25 Dec 2019

**[*]Corresponding author:**
Mehmet Rami Helvaci, Medical Faculty of the Mustafa Kemal University, Serinyol, Antakya, Hatay, Turkey, E-mail: mramihelvaci@hotmail.com

## 1. Abstract

### 1.1. Background

We tried to understand whether or not high density lipoproteins (HDL) may actually be some acute phase proteins (APP) in the plasma.

### 1.2. Methods

Patients with plasma HDL values lower than 40 mg/dL were collected into the first group, and then age and gender matched patients with plasma HDL values of 40 mg/dL and greater were collected into the second group, and compared in between.

### 1.3. Results

There were 75 patients in the first and 118 patients in the second groups. Mean age (45.4 versus 47.9 years) and male ratio (53.3 versus 53.3%) were similar in both groups ($p>0.05$ for both). Smoking (34.6 versus 31.3%), body mass index (27.2 versus 26.7 kg/m$^2$), fasting plasma glucose (119.4 versus 113.0 mg/dL), white coat hypertension (25.3 versus 32.2%), hypertension (10.6 versus 16.1%), and chronic obstructive pulmonary disease (14.6 versus 18.6%) were similar in both groups, too ($p>0.05$ for all). Although triglycerides (162.7 versus 125.4 mg/dL, $p<0.001$), diabetes mellitus (DM) (21.3 versus 12.7%, $p<0.05$), and coronary heart disease (CHD) (20.0 versus 11.0%, $p<0.05$) were higher, low density lipoproteins (LDL) (105.3 versus 126.2 mg/dL) and HDL (34.1 versus 50.0 mg/dL) were lower in patients with plasma HDL values of lower than 40 mg/dL, significantly ($p<0.000$ for both).

### 1.4. Conclusions

Although the similar mean age, gender distribution, and smoking in both groups, mean triglycerides, DM, and CHD were higher whereas LDL and HDL were lower in patients with plasma HDL values of lower than 40 mg/dL, significantly. So HDL may actually be some negative APP in the plasma.

**2. Keywords:** High density lipoproteins; Negative acute phase proteins; Metabolic syndrome

## 3. Introduction

Chronic low-grade endothelial inflammation may be the most common type of vasculitis, and the leading cause of aging in human being [1-4]. Much higher Blood Pressure (BP) of the afferent vasculature may be the major underlying cause by triggering recurrent injuries on endothelium. Probably whole afferent vasculature including capillaries are mainly involved in the process. Therefore the term of venosclerosis is not as famous as atherosclerosis in the literature. Secondary to the chronic low-grade endothelial injury, inflammation, edema, and fibrosis, vascular walls thicken, their lumens narrow, and

they lose their elastic natures, all of those reduce blood supply to the end-organs, and increase systolic BP further. Some of the well-known underlying causes and/or indicators of the inflammatory process are physical inactivity, animal-rich diet, overweight, smoking, alcohol, hypertriglyceridemia, hyperbetalipoproteinemia, impaired fasting glucose, impaired glucose tolerance, White Coat Hypertension (WCH), cancers, prolonged infections, and chronic inflammations [5, 6]. Some of the consequences of the chronic low-grade inflammatory process include obesity, Hyper Tension (HT), Diabetes Mellitus (DM), cirrhosis, Peripheric Artery Disease (PAD), Chronic Obstructive Pulmonary Disease (COPD), Chronic Renal Disease (CRD), Coronary Heart Disease (CHD), mesenteric ischemia, osteoporosis, stroke, end-organ insufficiencies, early aging, and premature death [7-9]. Although early withdrawal of the underlying causes may delay terminal consequences, after development of cirrhosis, COPD, CRD, CHD, PAD, stroke, or early aging, endothelial destructions can not be reversed effectively due to their fibrotic natures. The triggering etiologies and terminal consequences of the chronic low-grade inflammatory process are researched under the titles of metabolic syndrome, aging syndrome, or accelerated endothelial damage syndrome in the literature, extensively [10-13]. Similarly, plasma lipoprotein levels may be under dynamic control, and they may actually be some Acute Phase Proteins (APP) indicating inflammations anywhere of the body. Although their normal limit could not been determined clearly yet, high plasma triglycerides may be significant indicators of the metabolic syndrome [14]. Due to the significant association between high plasma triglycerides levels and CHD, Adult Treatment Panel (ATP) III adopts lower cutpoints for triglycerides than did ATP II [15, 16]. Although ATP II determined the normal upper limit of triglycerides as 200 mg/dL in 1994, World Health Organisation in 1999 [17] and ATP III in 2001 reduced the normal upper limit as 150 mg/dL [16]. Although these cutpoints, there are several reports about the lower and safer limits of the triglycerides in the literature [18-20]. Although the absolute significance of plasma triglycerides in the metabolic syndrome, role of High Density Lipoproteins (HDL) is suspicious [19]. We tried to understand whether or not HDL may actually be some APP in the plasma in the present study.

## 4. Material and Methods

The study was performed in the Internal Medicine Polyclinic of the Dumlupinar University between August 2005 and March 2007. Consecutive patients above the age of 15 year were studied. Their medical histories were learnt, and a routine check up procedure including Fasting Plasma Glucose (FPG), serum creatinine, liver function tests, markers of hepatitis viruses A, B, C and human immunodeficiency virus, triglycerides, low density lipoproteins (LDL), HDL, an electrocardiogram, and an abdominal ultrasonography was performed. A Doppler echocardiogram was performed just in required cases. Current daily smokers with six pack-months and cases with a history of three pack-years were accepted as smokers. Patients with devastating illnesses including type 1 DM, malignancies, hemodialysis, ascites, hyper- or hypothyroidism, and heart failure were excluded to avoid their possible effects on weight. Additionally, anti-hyperlipidemic drugs, metformin, and/or acarbose users were excluded to avoid their possible effects on blood lipid profiles and/or body weight [21, 22]. Body Mass İndex (BMI) of each case was calculated by the measurements of the Same Physician instead of verbal expressions. Weight in kilograms is divided by height in meters squared [16]. Cases with an overnight FPG level of 126 mg/dL or greater on two occasions or already using antidiabetic medications were defined as diabetics [16]. An oral glucose tolerance test with 75-gram glucose was performed in cases with a FPG level between 110 and 126 mg/dL, and diagnosis of cases with a 2-hour plasma glucose level of 200 mg/dL or greater is DM [16]. Additionally, Office Blood Pressure (OBP) was checked after a 5-minute of rest in seated position with a mercury sphygmomanometer on three visits, and no smoking was permitted during the previous 2-hour. A 10-day twice daily measurement of blood pressure at home (HBP) was obtained in all cases after a 10-minute education about proper BP measurement techniques [23]. An additional 24-hour ambulatory blood pressure monitoring was not required due to its similar effectivity with the HBP measurements [3]. Eventually, HT is defined as a mean BP of 135/85 mmHg or higher on HBP measurements, and WCH as an OBP of 140/90 mmHg or higher but a mean HBP measurement of lower than 135/85 mmHg [23]. An exercise electrocardiogram is performed just in cases with an abnormal electrocardiogram and/or angina pectoris. Coronary angiography is taken just for the exercise electrocardiogram positive cases. So CHD is diagnosed either angiographically or with the Doppler echocardiographic findings as the already developed movement disorders in the cardiac walls. The spirometric pulmonary function tests were performed in required cases and the criterion for diagnosis of COPD is post-bronchodilator forced expiratory volume in one second/forced vital capacity of less than 70% [24]. Eventually, patients with plasma HDL values of lower than 40 mg/dL were collected into the first group, and then age and gender matched patients with plasma HDL values of 40 mg/dL and greater were collected into the second group, respectively. Smoking, BMI, FPG, triglycerides, LDL, HDL, WCH, HT, DM, COPD, and CHD were detected in each group, and compared in between. Mann-Whitney U test, Independent-Samples T test, and comparison of proportions were used as the methods of statistical analyses.

## 5. Results

There were 75 patients in the first and 118 patients in the second groups. The mean age (45.4 versus 47.9 years) and male ratio (53.3 versus 53.3%) were similar in both groups (p>0.05 for both). Smoking (34.6 versus 31.3%), BMI (27.2 versus 26.7 kg/m$^2$), FPG (119.4 versus 113.0 mg/dL), WCH (25.3 versus 32.2%), HT (10.6 versus 16.1%), and COPD (14.6 versus 18.6%) were similar in both groups, too (p>0.05 for all). Although the mean triglycerides (162.7 versus 125.4 mg/dL, p<0.001), DM (21.3 versus 12.7%, p<0.05), and CHD (20.0 versus 11.0%, p<0.05) were higher, LDL (105.3 versus 126.2 mg/dL) and HDL (34.1 versus 50.0 mg/dL) were lower in patients with plasma HDL values of lower than 40 mg/dL, significantly (p<0.000 for both) (Table 1).

**Table 1:** Characteristics features of the study cases according to the plasma high density lipoproteins values

| Variable | Lower than 40 mg/dL | p-value | 40 mg/dL and higher |
|---|---|---|---|
| Number of cases | 75 | | 118 |
| Mean age (year) | 45.4 ± 15.2 (16-79) | Ns* | 47.9 ± 14.6 (19-77) |
| Male ratio | 53.30% | Ns | 53.30% |
| Smoking | 34.60% | Ns | 31.30% |
| BMI† (kg/m$^2$) | 27.2 ± 4.5 (18.4-39.9) | Ns | 26.7 ± 5.0 (17.8-42.4) |
| FPG‡ (mg/dL) | 119.4 ± 48.4 (76-287) | Ns | 113.0 ± 54.2 (63-400) |
| Triglycerides (mg/dL) | 162.7 ± 92.8 (43-470) | <0.001 | 125.4 ± 73.2 (27-410) |
| LDL§ (mg/dL) | 105.3 ± 33.1 (10-211) | <0.000 | 126.2 ± 29.5 (54-202) |
| HDL‖ (mg/dL) | 34.1 ± 3.8 (22-39) | <0.000 | 50.0 ± 9.1 (40-91) |
| WCH** | 25.30% | Ns | 32.20% |
| HT*** | 10.60% | Ns | 16.10% |
| DM**** | 21.30% | <0.05 | 12.70% |
| COPD***** | 14.60% | Ns | 18.60% |
| CHD****** | 20.00% | <0.05 | 11.00% |

*Nonsignificant (p>0.05) †Body mass index ‡Fasting plasma glucose §Low density lipoproteins ‖High density lipoproteins **White coat hypertension ***Hypertension ****Diabetes mellitus *****Chronic obstructive pulmonary disease ******Coronary heart disease

## 6. Discussion

Excess weight may be the most common cause of vasculitis worldwide since nearly three-fourths of cases above the age of 30 years have excess weight, nowadays [25]. Excess weight causes a chronic low-grade vascular endothelial inflammation, terminating with an accelerated atherosclerosis in whole body [26]. Adipose tissue produces leptin, tumor necrosis factor-alpha, plasminogen activator inhibitor-1, and adiponectin-like cytokines, all of those behave as APP in the plasma [27]. Beside that excess weight may cause an increased blood volume as well as an increased cardiac output due to the excessive fat tissue. The prolonged increase in the blood volume may lead to the myocardial hypertrophy and decreased cardiac compliance. Additionally, FPG and Total Cholesterol (TC) increased, parallel to the increased BMI values [28]. Combination of these cardiovascular risk factors will eventually terminate with an increase in left ventricular stroke work and higher risks of arrhythmias, cardiac failure, and sudden cardiac death. Similarly, the prevalences of CHD and stroke increased parallel to the increased BMI in the other study [29], and risk of death from all causes including cancers increased throughout the range of moderate to severe weight excess in all age groups [30]. The relationships between excess weight, increased BP, and higher plasma triglycerides values are well-known in the metabolic syndrome [14]. Similarly, prevalences of smoking (42.2 versus 28.4%, p<0.01), excess weight (83.6 versus 70.6%, p<0.01), DM (16.3 versus 10.3%, p<0.05), and HT (23.2 versus 11.2%, p<0.001) were all

higher in the hypertriglyceridemia patients in the other study [31]. On the other hand, the prevalences of hyperbetalipoproteinemia were similar both in the hypertriglyceridemia (200 mg/dL and greater) and control groups (18.9 versus 16.3%, $p>0.05$, respectively) [31]. Similarly, plasma LDL values increased just up to the plasma triglycerides value of 200 mg/dL in the above study [20]. Beside that, the mean BMI values increased just up to the plasma triglycerides value of 150 mg/dL, significantly ($p<0.05$ for each step) [20]. According to our opinion, overweight, obesity, severe obesity, and morbid obesity histories of years should be added into the calendar age with various degrees during calculation of physiological age.

Smoking and alcohol may be the second and third most common causes of vasculitis, respectively. According to our experiences, both of them should be included into the major components of the metabolic syndrome since they cause chronic inflammation on the vascular endothelium, terminating with an accelerated atherosclerosis in whole body. Tobacco's destructive effects are particularly prominent in the respiratory tract and lungs, probably due to the highest concentrations of toxic substances found in the cigarette smoke there. The strong and irreversible atherosclerotic effects of tobacco are the most clearly detected in the Buerger's disease. It is an obliterative vasculitis characterized by inflammatory changes in the small and medium-sized arteries and veins, and it has never been reported in the absence of smoking in the literature. Eventually, the atherosclerotic effects terminate with early aging, end-organ insufficiencies, and premature death [32]. According to our clinical observations, the smoking history of pack-years should be added into the calendar age during calculation of physiological age. Probably, alcohol gives harm to vascular endothelium by means of the similar ways with smoking but alcohol's main targets are the gastrointestinal tract and liver due to the highest concentrations of alcohol and its products there. Thus the drinking history of drink-years should also be added into the calendar age during calculation of physiological age. Due to the very low prevalence of alcoholism in Turkey [33], we did not include regular alcohol intake into the present study. On the other hand, although alcoholic drinks provide extra calories for body, smoking in human and nicotine administration in animals may be associated with a decreased BMI [34]. Evidence revealed an increased energy expenditure during smoking both on rest and light physical activity [35], and nicotine supplied by patch after smoking cessation decreased caloric intake in a dose-related manner [36]. According to an animal study, nicotine may lengthen intermeal time, and simultaneously decrease amount of meal eaten [37]. Additionally, BMI seems to be the highest in former and lowest in current smokers [38]. Smoking may be associated with a postcessation weight gain [39]. Similarly, although CHD was detected with similar prevalences in both genders, prevalences of smoking and COPD were higher in males against the higher BMI, LDL, triglycerides, WCH, HT, and DM in females in the previous study [40]. Additionally, the incidence of myocardial infarction is increased six-fold in women and three-fold in men who smoke 20 cigarettes per day [41]. In another definition, smoking may be more dangerous for women probably due to the higher BMI and its consequences in them. So smoking is probably a powerful atherosclerotic risk factor with some suppressor effects on appetite [42]. Smoking-induced appetite loss may be related with the smoking-induced vascular endothelial inflammation in whole body, since loss of appetite is one of the major symptoms of disseminated inflammation in the body. Physicians can even understand healing of patients by means of their normalizing appetite. Several toxic substances found in the cigarette smoke get into the circulation by means of the respiratory tract and lungs, and cause a vascular endothelial inflammation in whole body until the clearence from the circulation. But due to the repeated smoking habit of the individuals, the clearence never terminates. So the patients become ill with loss of appetite, permanently. In another explanation, smoking-induced weight loss is an indicator of being ill instead of being healthy [36-38]. After smoking cessation, appetite normalizes with a prominent weight gain but the returned weights are the patients' physiological weights, actually.

The prevalence of excess weight increased by decades, particularly after the third decade, up to the eight decade of life [25]. So $30^{th}$ and $70^{th}$ years of age may be the breaking points of life for body weight, and aging may be the major determiner factor of excess weight. Probably, partially decreased physical and mental stresses after the age of 30 years, and debility and comorbid disorders-induced restrictions after the age of 70 years may be the major causes of the changes of BMI at these ages. Interestingly, the mean age and BMI increased just up to the plasma triglycerides values of 200 mg/dL and 150 mg/dL in the above study, respectively [20]. So smoking was remained as the major causative factor of hypertriglyceridemia above the plasma triglycerides value of 200 mg/dL. Beside that, only cases with the plasma triglycerides values lower than 60 mg/dL had a normal mean BMI [20]. On the other hand, the triglycerides values increased about 8.1 mg/dL for each year of aging up to 200 mg/dL in the plasma [20] indicating that aging alone may be another risk factor for chronic low-grade inflammation on vascular endothelium

in whole body. Although ATP III reduced the normal upper limit of plasma triglycerides as 150 mg/dL in 2001 [16], the above study indicated that lower limits provide additional benefits for human health [20]. Similar to the recent study [43], prevalence of smoking was the highest in the highest triglycerides having group in the above study [20] that may also indicate inflammatory role of smoking in the metabolic syndrome, since triglycerides may actually be some APP in the plasma. FPG, BMI, HT, DM, and COPD increased parallel to the increased plasma triglycerides in the above study, gradually [20]. As one of our opinions, significantly increased mean age by the increased plasma triglycerides values may be secondary to aging-induced decreased physical and mental stresses, which eventually terminates with excess weight and its consequences. Interestingly, although the mean age increased from the lowest triglycerides having group up to the triglycerides value of 200 mg/dL, then it decreased. The similar trend was also seen with the mean LDL values. These trends may be due to the fact that although the borderline high triglycerides values (150-199 mg/dL) is seen together with physical inactivity and overweight, the high (200-499 mg/dL) and very high triglycerides values (500 mg/dL and greater) may be secondary to smoking, genetic factors, and terminal consequences of the metabolic syndrome including obesity, DM, HT, COPD, cirrhosis, CRD, PAD, CHD, and stroke [16]. But although the underlying causes of the high and very high plasma triglycerides values may be a little bit different, probably risks of the terminal endpoints of the metabolic syndrome do not change in them. For example, prevalences of HT, DM, and COPD were the highest in the highest triglycerides having group in the above study [20]. Eventually, although some authors reported that lipid assessment can be simplified by measurements of TC [44], the present study and most of the others indicated significant relationships between LDL, HDL, and triglycerides and terminal consequences of the metabolic syndrome [19, 20, 45]. Similar to the present study, the mean age, FPG, systolic and diastolic BP, TC, triglycerides, and HDL values increased gradually from the normal weight towards the overweight and obesity groups in the previous study [19] that may also indicate some bad prognostic roles of HDL in the metabolic syndrome.

HDL are one of the five major lipoproteins whose role is transport of cholesterol and triglycerides in the blood. HDL transport cholesterol from arteries back to the liver to be eliminated and/or transformed into other substances. These carrier lipoproteins in the plasma are under metabolic control, and are readily affected by diet, illnesses, drugs, and BMI. Thus lipid analysis should be performed during a steady state. But the metabolic syndrome itself is an abnormal condition with a low grade inflammatory process on vascular endothelium all over the body. Thus the metabolic syndrome alone may be a cause of abnormal lipoproteins levels in the plasma. Although HDL are commonly called as 'the good cholesterol' due to their roles in removing excess cholesterol from the blood and protecting the arterial walls against atherosclerosis, recent studies did not show similar results, and low plasma HDL levels may alert searching of additional metabolic and inflammatory pathologies in the body [46-48]. Normally, HDL may show various anti-atherogenic properties including reverse cholesterol transport and anti-oxidative and anti-inflammatory features [46]. However, HDL may become 'dysfunctional' in pathological conditions which means that relative composition of lipids and proteins, as well as the enzymatic activities of HDL are altered [46]. For example, properties of HDL are compromised in patients with DM due to the oxidative modification and glycation of HDL, as well as the transformation of HDL proteomes into proinflammatory proteins. Similarly, although the similar mean age, gender distribution, and smoking in both groups, DM was significantly higher in patients with plasma HDL values of lower than 40 mg/dL in the present study.

APP are a class of proteins whose plasma concentrations increase (positive APP) or decrease (negative APP) as a response to inflammation [49-51]. In response to injury, local inflammatory cells (neutrophils and macrophages) secrete a number of cytokines into the bloodstream, most notable of which are the interleukins. The liver responds by producing many APP. At the same time, production of many proteins is reduced. Thus these proteins are called as negative APP. Some of the well-known negative APP are albumin, transferrin, retinol-binding protein, antithrombin, and transcortin. The decrease of such proteins is also used as an indicator of inflammation. The physiological role of decreased synthesis of such proteins is generally to save amino acids for producing positive APP more effectively. Due to the decreased production of some proteins in liver during severe inflammatory conditions, production of HDL may also be suppressed. By this way, although the similar mean age, gender distribution, and smoking in both groups, the higher triglycerides, DM, and CHD in patients with plasma HDL values of lower than 40 mg/dL can be explained in the present study.

As a conclusion, although the similar mean age, gender distribution, and smoking in both groups, triglycerides, DM, and CHD were higher whereas LDL and HDL were lower in patients with plasma

HDL values of lower than 40 mg/dL, significantly. So HDL may actually be some negative APP in the plasma.

## References


1. Widlansky ME, Gokce N, Keaney JF Jr, Vita JA. The clinical implications of endothelial dysfunction. J Am Coll Cardiol. 2003; 42: 1149–1160.

2. Ridker PM. High-sensitivity C-reactive protein: potential adjunct for global risk assessment in the primary prevention of cardiovascular disease. Circulation. 2001; 103: 1813-8.

3. Helvaci MR, Seyhanli M. What a high prevalence of white coat hypertension in society! Intern Med. 2006; 45: 671-4.

4. Helvaci MR, Kaya H, Seyhanli M, Cosar E. White coat hypertension is associated with a greater all-cause mortality. J Health Sci. 2007; 53: 156-60.

5. Helvaci MR, Aydin Y, Gundogdu M. Smoking induced atherosclerosis in cancers. HealthMED. 2012; 6: 3744-9.

6. Fodor JG, Tzerovska R, Dorner T, Rieder A. Do we diagnose and treat coronary heart disease differently in men and women? Wien Med Wochenschr. 2004; 154: 423-5.

7. Helvaci MR, Kaya H, Yalcin A, Kuvandik G. Prevalence of white coat hypertension in underweight and overweight subjects. Int Heart J. 2007; 48: 605-13.

8. Helvaci MR, Kaya H, Duru M, Yalcin A. What is the relationship between white coat hypertension and dyslipidemia? Int Heart J. 2008; 49: 87-93.

9. Helvaci MR, Kaya H, Sevinc A, Camci C. Body weight and white coat hypertension. Pak J Med Sci.. 2009; 25: 916-21.

10. Eckel RH, Grundy SM, Zimmet PZ. The metabolic syndrome. Lancet. 2005; 365: 1415-28.

11. Grundy SM, Brewer HB Jr, Cleeman JI, Smith SC Jr, Lenfant C. Definition of metabolic syndrome: Report of the National Heart, Lung, and Blood Institute/American Heart Association conference on scientific issues related to definition. Circulation. 2004; 109: 433-8.

12. Tonkin AM. The metabolic syndrome(s)? Curr Atheroscler Rep. 2004; 6: 165-6.

13. Franklin SS, Barboza MG, Pio JR, Wong ND. Blood pressure categories, hypertensive subtypes, and the metabolic syndrome. J Hypertens. 2006; 24: 2009-16.

14. Helvaci MR, Kaya H, Gundogdu M. Association of increased triglyceride levels in metabolic syndrome with coronary artery disease. Pak J Med Sci. 2010; 26: 667-72.

15. National Cholesterol Education Program. Second Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II). Circulation. 1994; 89: 1333-445.

16. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. Circulation. 2002; 106: 3143-421.

17. World Health Organization. Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Report of a WHO consultation 1999.

18. Helvaci MR, Tonyali O, Abyad A, Pocock L. The safest value of plasma triglycerides. World Family Med. 2019; 17: 22-7.

19. Helvaci MR, Ayyildiz O, Gundogdu M, Aydin Y, Abyad A, Pocock L et al. Hyperlipoproteinemias may actually be acute phase reactants in the plasma. World Family Med. 2018; 16: 7-10.

20. Helvaci MR, Abyad A, Pocock L. The lowest is the safest value of plasma triglycerides. World Family Med. 2019; 17: 10-5.

21. Helvaci MR, Kaya H, Borazan A, Ozer C, Seyhanli M, Yalcin A et al. Metformin and parameters of physical health. Intern Med. 2008; 47: 697-703.

22. Helvaci MR, Aydin Y, Varan G, Abyad A, Pocock L. Acarbose versus metformin in the treatment of metabolic syndrome. World Family Med. 2018; 16: 10-5.

23. OBrien E, Asmar R, Beilin L, Imai Y, Mallion JM, Mancia G et al. European Society of Hypertension recommendations for conventional, ambulatory and home blood pressure measurement. J Hypertens 2003; 21: 821-48.

24. Vestbo J, Hurd SS, Agustí AG, Jones PW, Vogelmeier C, Anzueto A et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am J Respir Crit Care Med. 2013; 187: 347-65.

25. Helvacı MR, Kaya H, Ozer C. Aging may be the major determiner factor of excess weight. Middle East J Age and Ageing. 2008; 5.

26. Funahashi T, Nakamura T, Shimomura I, Maeda K, Kuriyama H, Takahashi M et al. Role of adipocytokines on the pathogenesis of atherosclerosis

in visceral obesity. Intern Med 1999; 38: 202–6.

27. Yudkin JS, Stehouwer CD, Emeis JJ, Coppack SW. C-reactive protein in healthy subjects: associations with obesity, insulin resistance, and endothelial dysfunction: a potential role for cytokines originating from adipose tissue? Arterioscler Thromb Vasc Biol. 1999; 19: 972-8.

28. Zhou B, Wu Y, Yang J, Li Y, Zhang H, Zhao L et al Overweight is an independent risk factor for cardiovascular disease in Chinese populations. Obes Rev. 2002; 3: 147-56.

29. Zhou BF. Effect of body mass index on all-cause mortality and incidence of cardiovascular diseases--report for meta-analysis of prospective studies open optimal cut-off points of body mass index in Chinese adults. Biomed Environ Sci. 2002; 15: 245-52.

30. Calle EE, Thun MJ, Petrelli JM, Rodriguez C, Heath CW Jr. Body-mass index and mortality in a prospective cohort of U.S. adults. N Engl J Med. 1999; 341: 1097-1105.

31. Helvaci MR, Aydin LY, Maden E, Aydin Y. What is the relationship between hypertriglyceridemia and smoking? Middle East J Age and Ageing 2011; 8.

32. Helvaci MR, Abyad A, Pocock L. Smoking-induced endothelial damage may increase plasma triglycerides. World Family Med. 2019; 17: 37-42.

33. Helvaci MR, Yaprak M, Abyad A, Pocock L. Atherosclerotic background of hepatosteatosis in sickle cell diseases. World Family Med. 2018; 16: 12-8.

34. Grunberg NE, Greenwood MR, Collins F, Epstein LH, Hatsukami D, Niaura R et al. National working conference on smoking and body weight. Task Force 1: Mechanisms relevant to the relations between cigarette smoking and body weight. Health Psychol. 1992; 11: 4-9.

35. Walker JF, Collins LC, Rowell PP, Goldsmith LJ, Moffatt RJ, Stamford BA et al. The effect of smoking on energy expenditure and plasma catecholamine and nicotine levels during light physical activity. Nicotine Tob Res. 1999; 1: 365-70.

36. Hughes JR, Hatsukami DK. Effects of three doses of transdermal nicotine on post-cessation eating, hunger and weight. J Subst Abuse. 1997; 9: 151-9.

37. Miyata G, Meguid MM, Varma M, Fetissov SO, Kim HJ. Nicotine alters the usual reciprocity between meal size and meal number in female rat. Physiol Behav. 2001; 74: 169-76.

38. Laaksonen M, Rahkonen O, Prattala R. Smoking status and relative weight by educational level in Finland, 1978-1995. Prev Med. 1998; 27: 431-7.

39. Froom P, Melamed S, Benbassat J. Smoking cessation and weight gain. J Fam Pract 1998; 46: 460-4.

40. Helvaci MR, Kaya H, Gundogdu M. Gender differences in coronary heart disease in Turkey. Pak J Med Sci. 2012; 28: 40-4.

41. Prescott E, Hippe M, Schnohr P, Hein HO, Vestbo J. Smoking and risk of myocardial infarction in women and men: longitudinal population study. BMJ. 1998; 316: 1043-7.

42. Helvaci MR, Aydin Y, Gundogdu M. Atherosclerotic effects of smoking and excess weight. J Obes Wt Loss Ther. 2012; 2: 145.

43. Helvaci MR, Tonyali O, Abyad A, Pocock L. Smoking may be a cause of hypertriglyceridemia. World Family Med. 2019; 17: 14-8.

44. Di Angelantonia E, Sarwar N, Perry P, Kaptoge S, Ray KK, Thompson A et al. Major lipids, apolipoproteins, and risk of vascular disease. JAMA. 2009; 302: 1993-2000.

45. Sarwar N, Sandhu MS, Ricketts SL, Butterworth AS, Di Angelantonia E, Boekholdt SM et al. Triglyceride-mediated pathways and coronary disease: collaborative analysis of 101 studies. Lancet. 2010; 375: 1634-9.

46. Femlak M, Gluba-Brzózka A, Cialkowska-Rysz A, Rysz J. The role and function of HDL in patients with diabetes mellitus and the related cardiovascular risk. Lipids Health Dis. 2017; 16: 207.

47. Ertek S. High-density lipoprotein (HDL) dysfunction and the future of HDL. Curr Vasc Pharmacol 2018; 16: 490-8.

48. März W, Kleber ME, Scharnagl H, Speer T, Zewinger S, Ritsch A et al. HDL cholesterol: reappraisal of its clinical relevance. Clin Res Cardiol. 2017; 106: 663-75.

49. Gabay C, Kushner I. Acute-phase proteins and other systemic responses to inflammation. N Engl J Med. 1999; 340: 448-54.

50. Schrödl W, Büchler R, Wendler S, Reinhold P, Muckova P, Reindl J et al. Acue phase proteins as promising biomarkers: Perspectives and limitations for human and veterinary medicine. Proteomics Clin Appl. 2016; 10: 1077-92.

51. Wool GD, Reardon CA. The influence of acute phase proteins on murine atherosclerosis. Curr Drug Targets. 2007; 8: 1203-14.