Journal of Cardiovascular Disease Research
ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 10, 2025

COMPARETIVE STUDY OF INFLAMOTORY MARKERS LIKE SERUM URIC ACID AND Hs-CRP BETWEEN METABOLIC AND NON-METABOLIC SYNDROME PATIENTS IN TERTIARY CARE CENTER OF WESTERN U.P– A CROSS SECTIONAL STUDY

Janki dosad Dr.Shorya taliyan Dr.Pawan parashar Dr. Saurabh singhal

Introduction - Metabolic syndrome (MetS) has become the most important issue in family medicine and primary care because it is a cluster of metabolic abnormalities that are burden on health care in many countries. Serum uric acid and Hs-CRP levels is reported to be associated with a variety of cardiometabolic risk factors. Thus, we examined and compared the association of serum uric acid and Hs-CRP concentration between the metabolic syndrome and non metabolic syndrome patients.

Material and Method-This is a cross sectional study conducted at tertiary health centre of Meerut from nov 2022 to oct 2023 with Total 212 patients (metabolic syndrome patients- 96 and non- metabolic syndrome patients - 116) attending community health centre.

Result: In our study the serum uric acid was significantly higher in metabolic syndrome group than non-metabolic syndrome group [mean 5.93 (2.17) vs 4.48 (1.35) p value- <0.001].

And the Hs-CRP was significantly higher in metabolic syndrome group than non-metabolic syndrome group [mean 3.87 (5.04) vs 2.49 (3.74) p value- <0.001].

Key words- MetS, CVD, NCEP-ATP III, NO, SUA and Hs-CRP.

Introduction

Metabolic Syndrome (MetS) is a complex web of metabolic factors that are associated with 2-fold risk of CVD and 5-fold risk of diabetes. Individuals with MetS have a 30%-40% probability of developing diabetes and/or CVD within 20 years, depending on the number of components present [1].

Metabolic syndrome has become the most common health challenge worldwide, crossing the barriers of age, sex and ethnicity. The risk factor associated with metabolic syndrome includes hypertension, hyperlipidemia, hyperglycemia, insulin resistance with a strong association with abdominal obesity. Patients with metabolic syndrome have been at an increased risk of developing CVD and T2 DM, making it one of the leading causes of early death[2].

NCEP-ATP III criteria requires three out of five factors to establish the diagnosis of MetS, i.e. abdominal obesity (waist circumference > 88 cm for women or > 102 cm for men), increased triglycerides (TG ≥ 150 mg/dL), reduced HDL chol (HDL-chol < 50 mg/dL for women or < 40 mg/dl for men), high blood pressure (BP ≥ 130/85 mmHg) and high fasting glucose (≥ 100 mg/dL)[3]. MetS is a state of chronic low grade inflammation as a consequence of complex interplay between genetic and environmental factors, inflammatory molecules seem to mediate the MetS components [4].

Uric acid is the end product of purine metabolism and is secreted by the kidney. Elevated levels of SUA can result from reduce renal clearance. Hyperinsulinemia has been postulated to decrease uric acid clearance by the kidneys and result of this increase serum uric acid [5].

Nitric oxide (NO) is the major endothelium-derived relaxing factor which is related with oxidative stress and insulin resistance. Uric acid diminishes the endothelial function and increase nitric synthase deficiency which reduces NO, a known mechanism for inducing insulin resistance [6]. Also, SUA has been found to be associated with cardiovascular disease in adults with or without impaired glucose tolerance [7]

CRP (C- reactive protein) is an acute-phase reactant and nonspecific marker of inflammation, produced predominantly in hepatocytes as a pentamer of identical subunits in response to several cytokines [8]. Interleukin (IL)-6, one of the most potent drivers of CRP production which is released from activated leukocytes in response to infection or trauma and from vascular smooth muscle cells in response to atherosclerosis. CRP directly binds highly atherogenic oxidized low-density lipoprotein cholesterol (LDL-C) and is present within lipidladen plaques [9]. The possible mechanistic role of CRP in plaque deposition is highly complex, exerting pro-atherogenic effects in many cells involved in atherosclerosis [5].

CRP may facilitate monocyte adhesion and transmigration into the vessel wall, which is the most critical and the early step in the atherosclerotic process [6]. Furthermore CRP, is a proinflammatory trigger in plaque deposition, leading to macrophage infiltration of both adipose tissue and atherosclerotic lesions [7].

The high-sensitivity CRP (Hs-CRP) varies from 0-5 mg/L in healthy young adults and is significantly associated with the metabolic syndrome and its components [10]. It is highly predictive of subsequent risk of cardiovascular events and diabetes mellitus in apparently

healthy men and women. Indeed, higher CRP levels provide additional prognostic information on cardiovascular risk in patients with metabolic syndrome [11]

Hyperuricemia has been shown to be associated with MetS in adult patients. Adults with increasing BMI over time show increased SUA and high sensitivity C-reactive protein (HsCRP) [12]. Serum uric acid has also been shown to correlate with liver dysfunction and increased inflammatory markers [10, 13]

In obese children, SUA, Hs-CRP and other inflammatory markers are elevated [14], which has been associated with excess weight and low cardiovascular fitness [15]. Prior studies have looked at SUA level in adolescent patients with metabolic syndrome and have shown a correlation between SUA and markers of inflammation and endothelial dysfunction in prepubertal children [14,16]. It has been shown that markers of inflammation and SUA are associated with biomarkers of insulin resistance and sequela of MetS in adolescents [16].

Thus, the following study is done to see the level of inflammatory markers (serum uric acid and Hs-CRP) in metabolic syndrome patients and to compare them with non metabolic syndrome patients.

Aims:

1) Compare the serum uric acid level in metabolic and non- metabolic syndrome patients.

2) Compare the serum Hs-CRP level in metabolic and non- metabolic syndrome patients.

Objective:

1) Screen the patients coming to outpatient department for metabolic syndrome.

2) Early identification of inflammatory markers in patients of metabolic syndrome.

MATERIAL AND METHOD

Present study is a hospital-based study conducted jointly by Department of Medicine, Department of Community Medicine and Department of Biochemistry, Subharti Medical College and its associated Chhatrapati Shivaji Subharti (CSS) Hospital Meerut.

Study design: cross sectional study

Study duration: November 2022 to October 2023

Sample size: Total 212 patients. (metabolic syndrome patients- 96 and non- metabolic syndrome patients - 116)

Subject and selection method: Individuals of age group 20 to 60 years attending the medicine OPD of Chhatrapati Shivaji Subharti (CSS) Hospital Meerut were included randomly in the study after fulfilling the inclusion and exclusion criteria. The age and sex of the subjects, present past and family history were taken from each patient and noted in the pre-designed research format. Routine blood investigation and systemic examination was carried out to diagnose out metabolic syndrome patients from total patients and findings were noted. Blood sample was taken from all patients for Inflammatory markers level assessment and findings were charted accordingly.

INCLUSION CRITERIA

Patients of age group 20 to 60 years attending Medicine OPD for different diseases

EXCLUSION CRITERIA:

- All pregnant female.
- Patient of age < 20 years and age > 60 years.
- Any other chronic illness.
- Acute and chronic inflammatory condition

DATA ANALYSIS- chi-square test (χ^2 test)

Measurement of Uric acid and Hs-CRP in all patients was done.

Type of sample: serum

Method: uricase

OBSERVATION AND RESULT

Metabolic syndrome					
	Present(96)		Absent(116)		
Parameters	**mean**	**median**	**mean**	**median**	**p-value**
Waist Circumference (Inch)	39.33 (3.98)	40 (36-42)	35.26 (4.15)	36 (32-38)	<0.001
HDL(Mg/dl**)**	43.19 (8.41)	42 (38-46)	50.49 (10.28)	51 (43-58)	<0.001
TG (mg/dl)	225.29 (88.63)	206.5 (169.75-276)	132.87 (66.01)	114 (90.75-147.25)	<0.001
Fasting glucose(mg/dl)	159.79 (95.45)	116 (85.5-217)	87.76(22.55)	84 (78.75-89.25)	<0.001
Systolic BP (mmHg)	135.17 (17.73)	132 (122.5-145.25)	123.16 (13.68)	120 (114-130)	<0.001
Diastolic BP (mmHg)	84.33 (10.89)	83.5 (75-91.25)	77.59 (9.72)	78 (70-83)	<0.001

Table 1: component of metabolic parameter in study population

The study population was examined and investigated on metabolic syndrome parameters as shown in table : 1.

The population is then divided into metabolic(96 patients) and non metabolic(116 patients) syndrome patients on the basis of clinical and blood investigation finding**.**

2.Association between 'Metabolic Syndrome' and 'Uric Acid (mg/dL)' (Full Sample)

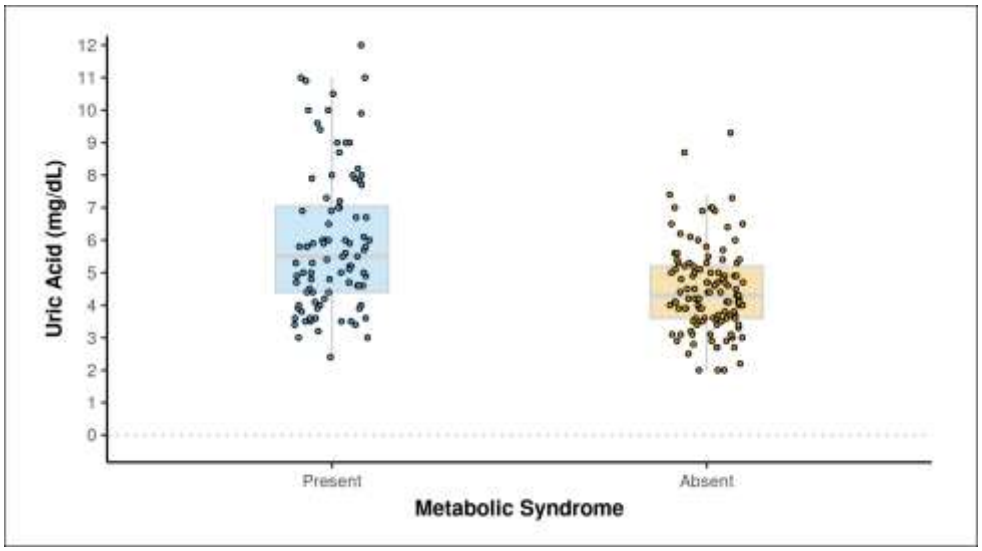
Uric Acid (mg/dL)	Metabolic Syndrome		Wilcoxon-MannWhitney U Test	
	Present(96)	Absent(116)	W	p value
Mean (SD)	5.93 (2.17)	4.48 (1.35)	7846.500	<0.001
Median (IQR)	5.5 (4.4-7.05)	4.3 (3.6-5.2)		
Min - Max	2.4 - 12	2 - 9.3		

The variable Uric Acid (mg/dL) was not normally distributed in the 2 subgroups of the variable Metabolic Syndrome. Thus, non-parametric tests (Wilcoxon-Mann-Whitney U Test) were used to make group comparisons.

The mean (SD) of Uric Acid (mg/dL) in the Metabolic Syndrome: Present group was 5.93 (2.17). The mean (SD) of Uric Acid (mg/dL) in the Metabolic Syndrome: Absent group was 4.48 (1.35). The median (IQR) of Uric Acid (mg/dL) in the Metabolic Syndrome: Present group was 5.5 (4.4-7.05). The median (IQR) of Uric Acid (mg/dL) in the Metabolic Syndrome: Absent group was 4.3 (3.6-5.2). The Uric Acid (mg/dL) in the Metabolic Syndrome: Present ranged from 2.4 - 12. The Uric Acid (mg/dL) in the Metabolic Syndrome: Absent ranged from 2 - 9.3.

There was a significant difference between the 2 groups in terms of Uric Acid (mg/dL) (W = 7846.500, p = <0.001), with the median Uric Acid (mg/dL) being highest in the Metabolic Syndrome: Present group.

Strength of Association (Point-Biserial Correlation) = 0.38 (Large Effect Size)



3.Association between 'Metabolic Syndrome' and 'hsCRP (mg/L)'

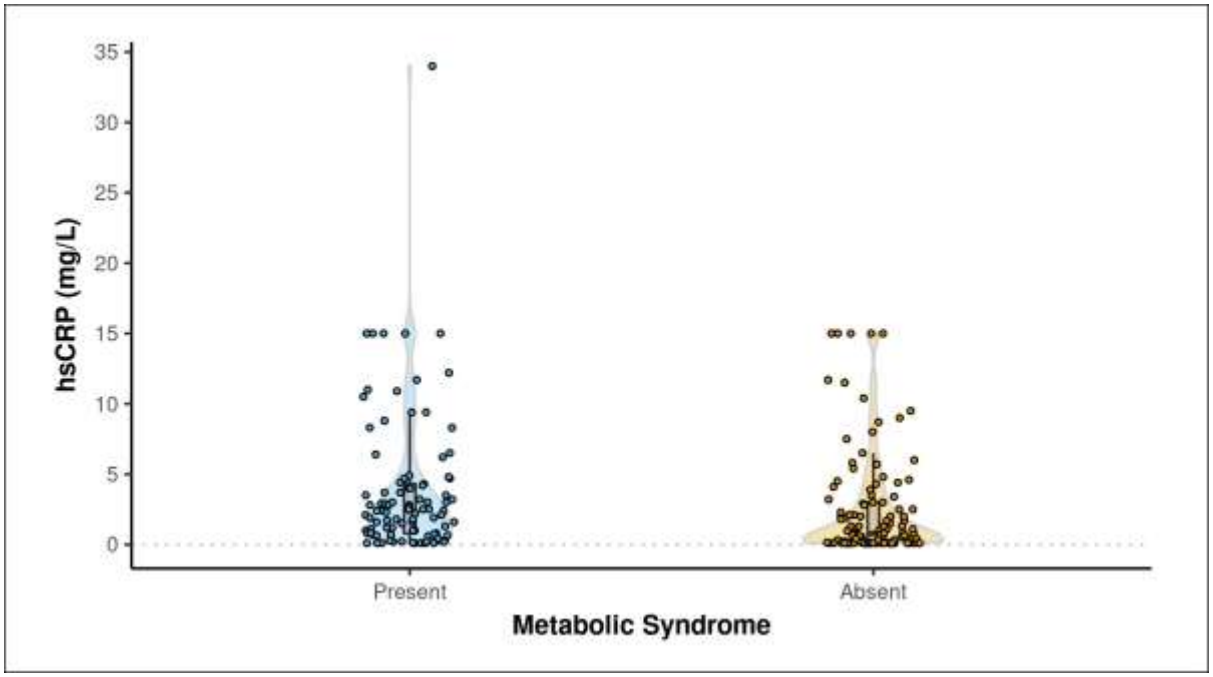
hsCRP (mg/L)	Metabolic Syndrome		Wilcoxon-MannWhitney U Test	
	Present(96)	Absent(116)	W	p value
Mean (SD)	3.87 (5.04)	2.49 (3.74)	7163.500	<0.001
Median (IQR)	2.4 (0.79-4.32)	0.78 (0.1-3)		
Min - Max	0.1 - 34	0.1 - 15		

The variable Hs-CRP (mg/L) was not normally distributed in the 2 subgroups of the variable Metabolic Syndrome. Thus, non-parametric tests (Wilcoxon-Mann-Whitney U Test) were used to make group comparisons.

The mean (SD) of Hs-CRP (mg/L) in the Metabolic Syndrome: Present group was 3.87 (5.04). The mean (SD) of Hs-CRP (mg/L) in the Metabolic Syndrome: Absent group was 2.49 (3.74). The median (IQR) of Hs-CRP (mg/L) in the Metabolic Syndrome: Present group was 2.4 (0.79-4.32). The median (IQR) of Hs-CRP (mg/L) in the Metabolic Syndrome: Absent group was 0.78 (0.1-3). The Hs-CRP (mg/L) in the Metabolic Syndrome: Present ranged from 0.1 - 34. The Hs-CRP (mg/L) in the Metabolic Syndrome: Absent ranged from 0.1 - 15.

There was a significant difference between the 2 groups in terms of Hs-CRP (mg/L) (W = 7163.500, p = <0.001), with the median Hs-CRP (mg/L) being highest in the Metabolic Syndrome: Present group.

Strength of Association (Point-Biserial Correlation) = 0.16 (Small Effect Size)



DISCUSSION:

In the present conditions that obesity is increasing at global level, metabolic syndrome will always be in the top of medical problems. Metabolic syndrome frequency is progressively increasing and evaluation of proinflammatory risk of this entity is valuable, as assessment of some inflammatory biomarkers implies minimum costs and it can be repeated [17].

Hyperuricemia can impair vascular function by exerting pro-oxidant effects and by decreasing NO bioavailability which like induces hypertension and MetS [18]. In adults, SUA has been seen as a biomarker for cardio-metabolic risk [19].

In our study, the incidence of hyperuricemia was observed in 45% in our population. The prevalence of hyperuricemia among adolescents with MetS is variable among different populations [20]. Ford et al. reported hyperuricemia prevalence of 59.9% among US children and adolescents using SUA level of 334uM.

In our study, those with MetS, SUA levels were significantly higher compared to those patients who did not meet criteria for MetS. These findings are consistent with a prior study that looked at adolescents and hyperuricemia. [21]

Hyperuricemia is well recognized as a risk factor for atherosclerotic diseases such as myocardial infarction and stroke. Its independent association with cardiometabolic risk factors remained controversial. In our study we found that hyperuricemia is a independent risk factor for metabolic syndrome which came out statistically significant.

Similar study by Zhang et al. showed that uric acid is an independent risk factor of MetS, and its higher concentrations increased the risk of MetS.

According to previous cardiovascular disease (CVD) studies, LDL-C in atheromatous plaques can be oxidized and enzyme-modified after the binding of Hs-CRP. Hs-CRP can deposit in plaques directly, and the proinflammatory property of Hs-CRP contributes to the pathogenesis of CVD [22,23] because atherosclerosis is also an inflammatory disease [24]. Furthermore, IL-6, a cytokine that induces HsCRP production in the liver, also accelerates inflammation in atherosclerosis [25]. Overall, the excessive adipocytes in patients with metabolic syndrome elevate proinflammatory substances, including Hs-CRP and interleukins in serum. Subsequently, these proinflammatory substances facilitate the atherogenic process from the initial chemotaxis of leukocytes in the arterial wall to the rupture of the plaque [26,27].

These studies explained the possible role of Hs-CRP in the connection between MetS. An intensive relationship between Hs-CRP and MetS was observed even after adjusting for other risk factors.

The results of our study not only implied that Hs-CRP could be an imperative connection of MetS with CVD and IR, but it also indicated that Hs-CRP could be an independent risk factor for MetS

Conclusion: metabolic syndrome is the major global health problem worldwide. Elevated uric acid and Hs-CRP level are both significantly associated with metabolic syndrome, they serve as useful markers for detection, risk stratification. Their elevation reflects underlying inflammation oxidative stress and metabolic dysregulation which are key components in the pathophysiology of metabolic syndrome.

Therefore we conclude that every individual of metabolic syndrome patients should be screen for serum uric acid and Hs-CRP, so that early identification of major disease can be done timely.

LACUNAE IN OUR STUDY: study population is small and only two inflammatory markers were taken. Result can vary on large study group with other inflammatory markers in study.

CONFLICTS OF INTRESET-nil

FIANICIAL SUPPORT AND SPONSORSHIP-nil

REFERENCES

1-Liu E, Meigs JB, Pittas AG, Economos CD, Mckeown NM, Booth SL, Jacques PF. Predicted 25-hydroxyvitamin D score and incident type 2 diabetes in the Framingham off-spring study. Am J Clin Nutr.2010; 91:1627-33

2- Park JE, Triupathi Pichiah PB, Cha YS. Vitamin D and Metabolic disease: growing role of Vitamin D. Journal of Obesity and Metabolic Syndrome, 2018; 27:223-232

3-Executive Summary of The 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). JAMA 2001;285:2486- 97. DOI: http://dx.doi.org/10.1001/jama.285.19.2486.

4.Kaur J (2014) A comprehensive review on metabolic syndrome. Cardiol Res Pract 2014:943162

5.Baldwin W, McRae S, Marek G, Wymer D, Pannu V, Baylis C, et al. Hyperuricemia as a mediator of the proinflammatory endocrine imbalance in the adipose tissue in a murine model of the metabolic syndrome. Diabetes. 2011;60(4):1258–69.

6.Li C, Hsieh MC, Chang SJ. Metabolic syndrome, diabetes, and hyperuricemia. Curr Opin Rheumatol. 2013;25(2):210–6.

7. Wijnands JM, et al. The cross-sectional association between uric acid and atherosclerosis and the role of low-grade inflammation: the CODAM study. Rheumatology (Oxford). 2014;53(11):2053–62

8.Alemzadeh R, Kichler J. Uric acid-induced inflammation is mediated by the parathyroid hormone:25-Hydroxyvitamin D ratio in obese adolescents. Metab Syndr Relat Disord. 2016;14(3):167–74

9.Han GM, Gonzalez S, DeVries D. Combined effect of hyperuricemia and overweight/obesity on the prevalence of hypertension among US adults: result from the National Health and nutrition examination survey. J Hum Hypertens. 2014;28(10):579–86

10. Pepys, MB, Hirschfield, GM. C-reactive protein: a critical update. JClin Invest 2003; 111(12): 1805-12.

11. Fröhlich M, Imhof A, Berg G, Hutchinson WL, Pepys MB, Boeing H, etal. Association between C reactive protein and features of the metabolic syndrome. Diabetes Care 2000; 23 (12): 1835-9.

12. HulseggeG, Herber-Gast GC, Spijkerman AM, SusanH, Picavet J, van der Schouw Y, et al. Obesity and age-related changes in markers of oxidative stress and inflammation across four generations. Obesity (Silver Spring). 2016;24(6):1389–96.

13.Li C, Hsieh MC, Chang SJ. Metabolic syndrome, diabetes, and hyperuricemia. Curr Opin Rheumatol. 2013;25(2):210–6.

14. ValleM, etal. Association of serum uric acid levels to inflammation biomarkers and endothelial dysfunction in obese prepubertal children. Pediatr Diabetes. 2015;16(6):441–7.

15.Reis LN, et al. Hyperuricemia is associated with low cardiorespiratory fitness levels and excess weight in schoolchildren. J Pediatr. 2017;93(5):538–43.

16.Wasilewska A, Tenderenda E, Taranta-Janusz K, Tobolczyk J, Stypuł kowska J. Markersof systemic inflammation in children with hyperuricemia. Acta Paediatr. 2012;101(5):497–500.

17. *Florez H, Castillo-Florez S, Mendez A, et al. – C-reactive protein is elevated in obese patients with the metabolic syndrome. Diabetes Res Clin. Pract 2006;*

18.Perez-RuizF, Becker MA. Inflammation: a possible mechanism for a causative role of hyperuricemia/gout in cardiovascular disease. Curr Med Res Opin. 2015;31(Suppl 2):9–14.

19.Silva HA, Carraro JC, Bressan J, Hermsdorff HH. Relation between uric acid and metabolic syndrome in subjects with cardiometabolic risk. Einstein (Sao Paulo). 2015;13(2):202–8.

20- FordES, LiC, CookS, Choi HK. Serum concentrations of uric acid and the metabolic syndrome among US children and adolescents. Circulation. 2007;115(19):2526–32.

21. Civantos Modino S, Guijarro de Armas MG, Monereo Mejías S, Montaño Martínez JM, Iglesias Bolaños P, Merino Viveros M, et al. Hyperuricemia and metabolic syndrome in children with over weight and obesity. Endocrinol Nutr. 2012;59(9):533–8.

22-Denegri, A .; Boriani, G. High Sensitivity C-reactive Protein (hsCRP) and its Implications in

Cardiovascular Outcomes. Curr. Pharm. Des. 2021, 27, 263–275. [CrossRef]

23. Singh, U.; Dasu, M.R.; Yancey, P.G.; Afify, A.; Devaraj, S.; Jialal, I. Human C-reactive protein promotes oxidized low density lipoprotein uptake and matrix metalloproteinase-9 release in Wistar rats. J. Lipid Res. 2008, 49, 1015–1023. [CrossRef]

24. Tuttolomondo, A.; Di Raimondo, D.; Pecoraro, R.; Arnao, V.; Pinto, A.; Licata, G. Atherosclerosis as an inflammatory disease. Curr. Pharm. Des. 2012, 18, 4266–4288. [CrossRef] [PubMed]

25. Tyrrell, D.J.; Goldstein, D.R. Ageing and atherosclerosis: Vascular intrinsic and extrinsic factors and potential role of IL-6. Nat. Rev. Cardiol. 2021, 18, 58–68. [CrossRef]

26. Soeki, T.; Sata, M. Inflammatory Biomarkers and Atherosclerosis. Int. Heart J. 2016, 57, 134–139. [CrossRef] [PubMed]

27. Rogoveanu, O.C.; Mogo¸sanu, G.D.; Bejenaru, C.; Bejenaru, L.E.; Croitoru, O.; Neam¸tu, J.; Pietrzkowski, Z.; Reyes-Izquierdo, T.; Bi¸tă, A.; Scorei, I.D.; et al. Effects of Calcium Fructoborate on Levels of C-Reactive Protein, Total Cholesterol, Low-Density Lipoprotein, Triglycerides, IL-1 , IL-6, and MCP-1: A Double-blind, Placebo-controlled Clinical Study. Biol. Trace Elem. Res. 2015, 163, 124–131. [CrossRef]