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Serum Myeloperoxidase, Xanthine Oxidase, and Oxidized Low-Density Lipoprotein As Determinants of Blood Pressure Among Abdominally Obese Adult Subjects

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Abstract

Background: Obesity is a risk factor for increased blood pressure, in which the relationship is mediated by the action of various pro-inflammatory mediators such as myeloperoxidase (MPO), xanthine oxidase (XO), and oxidized low-density lipoprotein (Ox-LDL). The objective of this research is to evaluate the contribution serum MPO, xanthine oxidase XO, and Ox-LDL as determinants of blood pressure in adults with abdominal obesity. **Methods:** A cross-sectional study was conducted involving 86 adults with abdominal obesity. Waist circumference (WC), fasting serum glucose (FSG), MPO, XO, and serum Ox-LDL were measured. The contributions of these parameters to systolic blood pressure (SBP) and diastolic blood pressure (DBP) were then assessed. **Results:** Multivariate analysis showed that the determinants of SBP were WC, FSG, MPO, and XO (Beta = 0.418, 0.328, 0.282, 0.248 respectively, all $p<0.05$; adjusted R^2 = 41.5%), while the determinants of DBP were FSG, WC, and MPO (Beta = 0.310, 0.284, 0.274, respectively, all $p<0.05$; adjusted R^2 = 24.8%). **Conclusions**: MPO has a role as a determining factor for SBP and DBP, XO has a role as a determining factor for SBP, while Ox-LDL does not have a significant role in blood pressure.

Keywords: MPO; XO; Ox-LDL; blood pressure; abdominal obesity

1. Introduction

Obesity is a state marked by excessive body fat mass, which has become a global problem with increasing prevalence in recent decades [1]. Fat deposition in intra-abdominal tissue causes a condition known as visceral/abdominal obesity, which is related closely to the incidence of metabolic and cardiovascular disorders [2,3]. Obesity can trigger insulin resistance, oxidative stress, and disrupt hemodynamics, which can ultimately lead to hypertension [4,5]. MPO is a heme peroxidase enzyme found in monocytes and neutrophils that plays a role in oxidative and inflammatory processes through its role as a catalyst for the formation of hypochlorous acid and has been reported to be associated with hypertension [6,7]. XO is an enzyme that has an important role in purine metabolism, producing uric acid, which in turn plays a role in the reactive oxygen species (ROS) formation that can trigger an increase in blood pressure [8–10]. Ox-LDL has an important role in the process of atherosclerosis, reducing the amount of endothelial nitric oxide (NO) synthase, which leads to vasoconstriction [11,12]. This research aims to measure the combined contribution of MPO, XO, and Ox-LDL to blood pressure in subjects with abdominal obesity.

2. Materials and Methods

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2.1. Study Design and Participants

This cross-sectional study was performed from October to December 2025 on 86 subjects with non-diabetic abdominal obesity (Asian population cut-off: WC ≥90 cm in males; ≥80 cm in females) [13]. Sampling was conducted at Hasanuddin University Hospital in Makassar, Indonesia, and laboratory tests were performed at the Hasanuddin University Medical Research Center (HUMRC). Subjects with a history of diabetes mellitus, current infection, inflammation, or who were taking cholesterol-lowering, uric acid-lowering, or anti-hypertensive drugs were excluded from the study. This study was ethically approved by the Health Ethics Committee, Medical Faculty, University of Hasanuddin, with recommendation number: 812/2025, protocol: UH25080659 (approved on 17th of October 2025).

2.2. Laboratory Tests

Patients were fasted overnight for 8-10 hours, then the following morning at 8 a.m., their body mass index (BMI), WC, SBP, DBP, and blood samples were measured. Blood pressure was measured using a Riester (Germany) mercury sphygmomanometer after the subjects had been seated for 15 minutes. FSG and 2-hour oral glucose tolerance test (OGTT) examinations were performed using Abx Pentra 400 (Horriba), while serum MPO (Elabscience, China), Ox-LDL (Elabscience, China), and XO (FineTest, China) examinations were performed using the enzyme-linked immunosorbent assay (ELISA) method.

2.3. Statistical Analysis

The normality of numerical data was assessed using the Kolmogorov-Smirnov test. The role of MPO, XO, Ox-LDL, WC, and other parameters in determining SDP and DBP was assessed using univariate and multivariate linear regression analysis. SDP and DBP were logarithmically transformed to normalize the data. All statistical tests were performed using the Statistical Package for the Social Sciences (SPSS) version 21.

3. Results

3.1. Characteristics of Study Subjects

Eighty-six research subjects consisting of 68 females (79.1%) and 18 males (20.9%) participated in this study. The basic characteristics of the research subjects are shown in Table 1.

Table 1. Basic characteristics of subjects.

Variables	Mean±SD	Median (Min-Max)
Age (years)	34.81±3.05	35 (28-42)
Height (cm)	157.19±7.10	156 (143-172)
Weight (kg)	69.17±11.02	68.70 (48.80-100.00)
BMI (kg/m2)	27.88±3.29	27.60 (20.60-37.20)
WC (cm)	93.07±6.82	93 (81-106)
SBP (mmHg)	120.60±13.65	119 (94-158)
DBP (mmHg)	78.40±10.83	78 (52-100)
FSG (mg/dL)	95.31±10.98	94.20 (74.80-120.80)
OGTT (mg/dL)	11.45±25.27	108.20 (68.60-156.30)
XO (ng/mL)	1.25±0.80	1.02 (0.30-4.30)
MPO (pg/mL)	33.32±38.65	19.94 (7.01-205.02)
Ox-LDL (pg/mL)	1660.73±880.75	1455.52 (458.11-4740.39)

Abbreviations: BMI, body mass index; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure; FSG, fasting serum glucose; OGTT, oral glucose tolerance test; XO, xanthine oxidase; MPO, Myeloperoxidase; Ox-LDL, oxidized low-density lipoprotein.

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3.2. Determinant Factors of SBP (Univariate Analysis)

Univariate linear regression analysis regarding the determinant factors of log SBP is shown in Table 2.

Table 2. Univariate linear regression analysis of log SBP determinant factors.

Variables	B	Standard Error	Beta	p	Adjusted R^2
Ox-LDL	-1.560E-006	0.000	-0.029	0.793	0.011
MPO	0.000	0.000	0.230	0.033	0.042
WC	0.004	0.001	0.531	<0.001	0.274
XO	0.016	0.006	0.264	0.014	0.059
FSG	0.001	0.000	0.279	0.009	0.067
Age	-0.001	0.002	-0.071	0.514	0.005

Abbreviations: WC, waist circumference; SBP, systolic blood pressure; FSG, fasting serum glucose; XO, xanthine oxidase; MPO, Myeloperoxidase; Ox-LDL, oxidized low-density lipoprotein.

3.3. Determinant Factors of SBP (Multivariate Analysis)

Multivariate linear regression analysis reveals that WC, FSG, serum MPO, and XO levels are determinant factors accounting for 41% of the log SBP variability, as shown in Table 3.

Table 3. Multivariate linear regression analysis of log SBP determinant factors.

Variables	B	Standard Error	Beta	p	Adjusted R^2
Constant	1.725	0.076	-	<0.001	
Ox-LDL	-5.261E-006	0.000	-0.097	0.274	
MPO	0.000	0.000	0.282	0.006	
WC	0.003	0.001	0.418	<0.001	$R^2 = 0.415$
XO	0.015	0.005	0.248	0.007	
FSG	0.001	0.000	0.328	0.001	
Age	-0.002	0.001	-0.142	0.113	

Abbreviations: WC, waist circumference; SBP, systolic blood pressure; FSG, fasting serum glucose; XO, xanthine oxidase; MPO, Myeloperoxidase; Ox-LDL, oxidized low-density lipoprotein.

3.4. Determinant Factors of DBP (Univariate Analysis)

Univariate linear regression analysis regarding determinant factors of log DBP is shown in Table 4.

Table 4. Univariate linear regression analysis of log DBP determinant factors.

Variables	B	Standard Error	Beta	p	Adjusted R^2
Ox-LDL	-1.160E-005	0.000	-0.167	0.124	0.016
MPO	0.000	0.000	0.217	0.045	0.036
WC	0.003	0.001	0.356	0.001	0.116
Age	-0.004	0.002	-0.191	0.079	0.025
FSG	0.001	0.001	0.233	0.031	0.043
XO	0.000	0.008	-0.004	0.97	0.012

Abbreviations: WC, waist circumference; DBP, diastolic blood pressure; FSG, fasting serum glucose; XO, xanthine oxidase; MPO, Myeloperoxidase; Ox-LDL, oxidized low-density lipoprotein.

3.5. Determinant Factors of DBP (Multivariate Analysis)

Multivariate linear regression analysis reveals that FSG, WC, and serum MPO levels are determinant factors accounting for 24.8% of the log DBP variability, as shown in Table 5.

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Table 5. Multivariate linear regression analysis of log DBP determinant factors.

Variables	B	Standard Error	Beta	p	Adjusted R^2
Constant	1.632	0.111	-	<0.001	
Ox-LDL	-1.247E-005	0.000	-0.180	0.075	
MPO	0.000	0.000	0.274	0.017	
WC	0.003	0.001	0.284	0.006	$R^2 = 0.248$
Age	-0.004	0.002	-0.201	0.059	
FSG	0.002	0.001	0.310	0.006	
XO	0.002	0.008	0.032	0.751	

Abbreviations: WC, waist circumference; DBP, diastolic blood pressure; FSG, fasting serum glucose; XO, xanthin oxidase; MPO, Myeloperoxidase; Ox-LDL, oxidized low-density lipoprotein.

4. Discussion

Obesity is one of the main causes of hypertension, where the relationship between them is mediated by various factors, including increased oxidative stress [4]. This study shows that in subjects with abdominal obesity, 41.5% of SBP variability is determined by serum MPO, XO, WC, and FSG, while 24.8% of DBP variability is determined by serum MPO, WC, and FSG. MPO has a slightly higher contribution to SBP variability than XO (Beta = 0.282 vs 0.248). Ox-LDL was found to have no direct contribution to either SBP or DBP.

The involvement of MPO in hypertension, coronary heart disease, and cardiovascular disease has been reported [6,14]. Buljubasic et al. observed higher serum MPO levels in hypertensive adults compared to normotensive individuals [15]. Another study in obese children revealed a positive association between serum MPO levels with SBP and DBP ($r = 0.357$ and 0.354; $p<0.05$) [16]. MPO produced by infiltrating neutrophils in perivascular tissues can lead to the formation of ROS, which may cause vascular dysfunction. The ROS that are formed also reduce the bioavailability of NO, thereby reducing the vasodilatory capacity of blood vessels and causing hypertension [17].

The impact of XO on blood pressure has also been reported in several studies. Serum XO levels have been reported to correlate positively with SBP and DBP ($r = 0.309$ and 0.180; P<0.0%) in adult populations [8]. Other studies have reported findings similar to the present study, showing an increase in SBP with increasing serum XO quartiles but finding no relationship between DBP and serum XO quartiles [18]. Another study reported higher serum XO and MPO levels in subjects with age-related cataracts accompanied by hypertension compared to those without hypertension; however, the contribution of XO and MPO to hypertension in that study was not investigated [10]. XO, which plays a role in the metabolism of purine to uric acid, can produce ROS byproducts, which cause endothelial and vascular dysfunction, suppress NO levels, and cause vasoconstriction and increased blood pressure [8,18].

Ox-LDL is a compound that is pro-oxidant, pro-inflammatory, and pro-thrombotic, which can cause endothelial dysfunction and atherosclerosis [11]. A study in an elderly population showed that Ox-LDL is associated with arterial stiffness [19]. However, in line with the results of this study, Harmon et al. reported that no association was found between Ox-LDL with SBP and DBP in the adult population [20]. This suggests that although Ox-LDL plays a role in the early formation of atherosclerotic plaques, it is not directly related to increased blood pressure, especially among young adults, as in the subjects of this study.

Studies that evaluate the combined contribution of MPO, XO, and Ox-LDL to SBP and DBP in the abdominally obese population are still rare. This study demonstrates the contribution of MPO and XO to blood pressure elevation. There are several limitations to this study. The cross-sectional study design cannot prove a causal relationship between variables. Multicenter studies involving different populations and a larger number of subjects are needed to generalize the findings of this study.

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5. Conclusions

MPO has a role as a determining factor for SBP and DBP, XO has a role as a determining factor for SDP, while Ox-LDL does not have a significant role in blood pressure.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by Health Ethics Committee, Medical Faculty, University of Hasanuddin, with recommendation number: 812/2025, protocol: UH25080659 (approved on 17th of October 2025).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Due to ethical and privacy concerns, the data in this study can be obtained from the corresponding author upon acceptable request.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

BMI	Body mass index
DBP	Diastolic blood pressure
HUMRC	Hasanuddin University Medical Research Center
MPO	Myeloperoxidase
NO	Nitric oxide
OGTT	Oral glucose tolerance test
Ox-LDL	Oxidized low-density lipoprotein
ROS	Reactive oxygen species
SBP	Systolic blood pressure
SPSS	Statistical Package for the Social Sciences
WC	Waist circumference
XO	Xanthine oxidase

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