DOI Number: 10.5958/0976-5506.2019.01681.4

# Hyperglycemic and Hypertension are Major Component of Metabolic Syndrome that Caused Circulatory Morbidity in Hajj Pilgrims

**Iche Andriyani Liberty[1,2], Nasrin Kodim[2], Mukaramah[2]**

*[1]Department of Public Health and Community Medicine, Medical Faculty of Sriwijaya University, Palembang, Indonesia; [2]Department of Epidemiology, Public Health Faculty of Universitas Indonesia, Depok Indonesia*

## ABSTRACT

Hajj is a community that needs special attention, the series of worship activities during in the holy places in Makkah and Madinah must be supported by physical and mental prime. One of the health problems has related to circulatory disease. This study presents the impact of metabolic syndrome (hyperglycemic, hypertension, and obesity) that caused circulatory morbidity in Indonesian Hajj Pilgrims. The design study is Retrospective Cohort, conducted on 152,429 Indonesian pilgrims departing in the Hajj season 2016/1437H sourced from The Siskohatkes data of the Ministry of Health of the Republic of Indonesia. The prevalence of metabolic syndrome (hyperglycemic, hypertension, and central obesity) on Indonesian pilgrims 1.6% and significant differences were found in all characteristic: sex, age, employment, and education, BMI, istitha'ah, and smoking behaviour. Hyperglycemic had greater HR than hypertension and central obesity with HR of 2.06 (1.63-2.60) adjusted by BMI, smoking, age, and sex as a risk of inpatient care. While, hypertension had greater HR than hyperglycemic and central obesity with HR 2.04 (1.99-2.09) adjusted by smoking, age, and sex as a risk of outpatient care in the holy places in Makkah or Madinah. Regulation for additional history of drugs consumed on screening of pre-existing disease before departure is needed.

***Keywords:*** *hyperglycemic, hypertension, Mets, hajj, morbidity*

## Introduction

Metabolic syndrome (MetS) is a complex disorder characterized by abdominal obesity, impaired glucose metabolism, atherogenic dyslipidemia and hypertension.[1,2] A systematic review of epidemiologic data from the Middle East reports a prevalence of MetS in men of 20.7-37.2% and 32.1-42.7% in women. Increasing trend of circulatory disease followed by ignored active health policies to control the risk factors, but studies are available that discusses the risk factors of circulatory disease has not been found, especially that associated with metabolic syndrome. [1,3, 4]

**Corresponding Author:**
Iche Andriyani Liberty
Department of Public Health and Community Medicine, Medical Faculty of Sriwijaya University Palembang, Indonesia
Email: iche.aliberty@gmail.com

Circulatory disease, which is customarily defined as those causes of mortality and morbidity with International Classification of Diseases 10th revision (ICD10) codes I00-I99 (or equivalently the International Classification of Diseases 8th or 9th revision (ICD8, ICD9) codes 390–459). Major types of circulatory disease are Arteriosclerosis, Cardiac valve diseases, Cardiac arrhythmias, Cardiomyopathy, Cerebrovascular disease (CeVD), Hypertensive disease, Ischemic heart disease (IHD), Pericarditis.[3]

Hajj is a community that needs special attention. the series of worship activities during in holy places in Makkah and Madinah must be supported by physical and mental prime. One of the health problems facing the congregation is related to circulatory disease. Blood glucose, triglyceride, HDL, LDL, cholesterol, blood pressure, and physical anthropometry such as weight and height and abdominal circumference are some of the variables that can be an indicator of cardiometabolic risk and have been measured before pilgrims leave. Hajj

pilgrims who are large populations are expected to become populations representing the community in providing predictive values related to metabolic syndrome and their impact on circulatory morbidity that are major problems and causes of major deaths worldwide.

## Method

**Study Design and Study Protocol:** This study used secondary data SISKOHATKES 2016 with Retrospective Cohort Study design, conducted on all Indonesian pilgrims departing on the Haj season 2016/1437H. The target population of all Indonesian pilgrims departing during the Hajj season 2016 and recorded in the initial examination SISKOHATKES 2016. Population study has 152,429 pilgrims in 2016 who conduct medical tests.

**Measurements and Calculations:** Before departure, all Indonesian pilgrims are required to visit a government health facility for a medical examination and to receive a pocket book that outlines their health condition. Clinical identification of patients with the features of MetS was based on the criteria proposed by the NCEP-ATPIII (National Cholesterol Education Program Adult Treatment Panel III). Patients were considered to have MetS when three of the following five criteria were met: 1) waist circumference ≥ 102 cm in men and 88 cm in women; 2) fasting hyperglycemic ≥ 110 mg/dL or using diabetes medications; 3) triglycerides ≥ 150 mg/dL or taking triglyceride lowering agents; 4) HDL cholesterol < 40 mg/dL for men; < 50 mg/dL for women or taking cholesterol-lowering agents; and 5) hypertension (systolic blood pressure ≥130 diastolic blood pressure ≥85) or using antihypertensive medication. Body mass index (BMI) was calculated as weight (kg) divided by height (m) squared (kg/m$^2$). The criteria used to define overweight were underweight (<18.5); Normal weight (18.5 -24.9kg/m$^2$); Overweight (25.0-29.9kg/m$^2$); Obesity Grade I (30.0-34.9kg/m$^2$); Obesity Grade II (35.0-39.9kg/m$^2$); and Extreme Obesity as BMI of ≥40 kg/m$^2$. Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 15 of 2016 on Istitha'ah explained that the ability to perform the pilgrimage physically, mentally and provision.

**Statistical Analysis:** Processing and analysis were performed using statistical program STATA 15. Univariate analysis was performed to see the distribution of each variable and parameter estimation of the variables presented in tables, and bivariate analysis using Chi Square test. Multivariate analysis using Cox Regression to determine the hazard ratio of cardiometabolic factors on the impact of morbidity from cardiovascular disease. Before the variable entered in multivariate analysis, first tested proportional hazard. The test is conducted to determine whether the candidate variables has a proportional hazard over time or not.

## Findings

All 15,429 Indonesian pilgrims were aged 18 years or more. where the prevalence of metabolic syndrome was 1.6% (2,450 pilgrimages). Most pilgrims had metabolic syndrome were female 1.8% and aged 50-59 years (Table 1). The prevalence of Mets (hyperglycemic, hypertension, and central obesity) on Indonesian pilgrims 1.6% and significant differences were found in all characteristic: sex, age, employment, and education, BMI, istitha'ah, and smoking behavior. Majority pilgrims with Mets were female (1.8%), aged 50-59 years (2.15%), military/police (2.0%), low education (1.7%), extreme obesity (3.0%), not qualified temporarily of istitha'ah (2.8%), and did not smoking (1.7%).

**Table 1: Indonesian Hajj Pilgrims Characteristic and Metabolic Syndrome**

| Variables | Mets | | Total | P-value |
|---|---|---|---|---|
| | Yes (n = 2,450) | No (n = 149,979) | (n = 152,429) | |
| **Sex** | | | | |
| Female | 1,563 (1.8%) | 83,156 (98.2%) | 84,719 | 0.000 |
| Male | 887 (1.3%) | 66,823 (98.7%) | 67,710 | |
| **Age** | | | | |
| <40 years | 42 (0.3%) | 14,749 (99.7%) | 14,791 | 0.000 |
| 40-49 years | 408 (1.1%) | 36,905 (98.9%) | 37,313 | |
| 50-59 years | 1,104 (2.1%) | 51,695 (97.9%) | 52,799 | |
| >60 years | 896 (1.9%) | 46,630 (98.1%) | 47,526 | |

*Conted…*

| | | | | |
|---|---|---|---|---|
| **Employment** | | | | |
| Military/Police | 27 (2.0%) | 1,328 (98%) | 1,355 | 0.000 |
| Farmer | 448 (1.4%) | 31,882 (98.6%) | 32,330 | |
| Goverment Employment | 1,021 (1.5%) | 66,261 (98.5%) | 67,282 | |
| Others | 954 (1.9%) | 50,508 (98.1%) | 51,462 | |
| **Education** | | | | |
| Low | 958 (1.8%) | 51,813 (98.2%) | 52,771 | 0.000 |
| Middle | 870 (1.6%) | 53,541 (98.4%) | 54,411 | |
| High | 622 (1.4%) | 44,625 (98.6%) | 45,247 | |
| **BMI** | | | | |
| Under weight | 16 (0.2%) | 7,160 (99.8%) | 7,176 | 0.000 |
| Normal weight | 827 (1.1%) | 72,044 (98.9%) | 72,871 | |
| Over weight | 1,136 (2.0%) | 54,822 (98.0%) | 55,958 | |
| Obese grade I | 370 (2.8%) | 12,948 (97.2%) | 13,318 | |
| Obese Grade II | 75 (3.2%) | 2,235 (96.8%) | 2,310 | |
| Extreme Obesity | 26 (3.3%) | 770 (96.7%) | 796 | |
| **Istitha'ah** | | | | |
| Qualified | 1,034 (1.6%) | 62,369 (98,4%) | 63,403 | 0.000 |
| Qualified with assistance | 224 (2.6%) | 8,241 (97.4%) | 8,465 | |
| Not qualified temporarily | 1,192 (2.8%) | 41,749 (97.2%) | 42,941 | |
| Not qualified | 0 (0.0%) | 48 (100%) | 48 | |
| **Smoking** | | | | |
| Yes | 187 (1.1%) | 16,403 (98.9%) | 16,590 | 0.000 |
| No | 2,263 (1.7%) | 133,576 (98.3%) | 135,839 | |

*Chi Square test. sig = 0.05

Table 2 from multivariate analysis with cox regression showed the results obtained that hyperglycemic had greater HR value than hypertension and central obesity with HR of 2.06 (1.63-2.60) adjusted by BMI, smoking, age, and sex. This means that pilgrims who before departure have clinical considents with hyperglycemic have a risk of 2.06 times to have circulatory disease and hospitalized (inpatient care) while performing the pilgrimage in the holy places in makkah or madinah.

**Tabel 2: Multivariate Analysis of Associated Mets and Inpatient Care Caused of Circulatory Disease**

| Variables | Inpatient Care | | Total (n=152,429) | HR 95% CI | p-value |
|---|---|---|---|---|---|
| | Yes (n = 1,847) | No (n = 150,582) | | | |
| **Hyperglycemic** | | | | | |
| Yes | 80 (0.9%) | 8,734 (99.1%) | 8,814 | 2.06 (1.63-2.60) | 0.000 |
| No | 593 (0.4%) | 143,022 (99.6%) | 143,615 | | |
| **Hypertension** | | | | | |
| Yes | 315 (0.8%) | 39,664 (99.2%) | 39,979 | 1.73 (1.48-2.02) | 0.000 |
| No | 358 (0.3%) | 112,092 (99.7%) | 112,450 | | |
| **Central Obesity** | | | | | |
| Yes | 353 (0.4%) | 95,845 (99.6%) | 96,198 | 0.8 (0.65-0.95) | 0.000 |
| No | 320 (0.6%) | 55,911 (98.4%) | 56,231 | | |

*Adjusted HR by BMI, smoking, age, and sex.

Different results (table 3) were obtained in outpatients during the holy places in makkah or madinah, where prior to hypertension had greater HR than hyperglycemic and central obesity with HR 2.04 (1.99-2.09) adjusted by smoking, age, and sex.

**Tabel 3: Multivariate Analysis of Associated Mets and Outpatient Care Caused of Circulatory Disease**

| Variables | Outpatient Care | | Total | HR 95% CI | Sig |
|---|---|---|---|---|---|
| | Yes | No | | | |
| **Hyperglycemic** | | | | | |
| Yes | 2,085 (23.7%) | 6,729 (76.3%) | 8,814 | 1.21 (1.16-1.27) | 0.000 |
| No | 25,405 (17.7%) | 118,210 (82.3%) | 143,615 | | |
| **Hypertension** | | | | | |
| Yes | 12,868 (32.2%) | 27,111 (67.8%) | 39,979 | 2,04 (1.99-2.09) | 0.000 |
| No | 14,622 (13.0%) | 97,828 (87.0%) | 112,450 | | |
| **Central Obesity** | | | | | |
| Yes | 27,490 (18.0%) | 77,541 (80.6% | 96,198 | 1.09 (1.06-1.13) | 0.000 |
| No | 8,833 (15.7%) | 47,398 (84.3%) | 56,231 | | |

*Adjusted HR by smoking, age, and sex.

## Discussion

MetS is an increasingly common cause of morbidity and mortality and has been reported with many postulated pathophysiologic diseases. Prevalence of metabolic syndrome is high among Asians and is rising, particularly with the adoption of modernized lifestyle.[2] The most commonly associated with insulin, along with proinflammatory, prothrombotic, and low grade oxidative status.[5] In this research, age and sex has associated with Mets and in multivariable analysis, age is confounding variable. With respect to age, MetS prevalence rates were higher in older, relative to younger, elderly subjects; however, this difference was nonsignificant. In general, the prevalence of MetS increases with age.[6]

Aging is one of the diverse and functional that occurs from time to time. These terms also affect biological functions after reaching their maximum potentials. During aging, sex steroid hormone is reduced and sex hormones that bind globulin increase, the rate of decrease in free hormone levels. Therefore, the reproductive and non-reproductive actions of sexual steroid hormones decreased significantly. However, there are major differences in the prevalence, timing of onset and severity of many conditions such as metabolism and disease, which are different from men and women and protective roles. [7,8]

There is more evidence that different sex is important in epidemiology, pathophysiology, treatment and results in many diseases include hyperglycemic. Increased insulin secretion is observed in both sexes, both of which have sufficient compensation to approach the normal curve, derived from the control of normal weight on the subject. Insulin sensitivity disorders and insulin secretion are equally strong and similar in both sexes. The evidence is confirmed as well as introducing age and BMI as covariates into the entire population: that is, insulin sensitivity decreases with increasing BMI in the same rate for men and women in all categories of glucose tolerance; while insulin secretion increases with BMI on a faster rate in men, it is better to compensate for the increase insulin resistance. This trend may partly explain why, in general, women are better at insulin sensitivity than men in normoglycemic states. This may be related to sex hormones and their receptors, different body fat distributions and associated biomarkers, such as higher adiponectin. Estrogen shows a protector effect of cell apoptosis, stimulates the beta cell secretion and increased insulin sensitivity with antidiabetic effects mainly described to ERα.[9]

Meta-analysis of prospective cohort studies found in populations with MetS defined by NECP have a significantly higher risk of incident stroke than those without MetS and higher in women compared with men, which was in agreement with a few studies.[10] Proper identification of Mets in hypertension can provide better predictions of poor cardiovascular events and models that can be used for specific factors.[11]

Each component of the MetS is an independent risk factor for cardiovascular disease, together producing a wide spectrum of vascular and cardiac diseases.[12] Each component of cardiovascular disease, related to the spectrum of cardiovascular conditions including microvascular dysfunction, coronary atherosclerosis and calcification, cardiac dysfunction, myocardial infarction, and heart failure.[13]

The obesity relationship observed with hypertension makes the body work exploring the causes and effects of obesity on the heart. Chronic weight gain and adiposity can lead to significant neurohormonal changes and adaptation to the cardiovascular system. These changes include activation of the renin angiotensin-aldosterone system, changes in adipocytokines levels, and proinflammatory cytokines, and sympathetic nervous system activation. Activation of the sympathetic nervous system may contribute to increased heart rate, renal sodium retention, blood volume circulation, ventricular end (preload), cardiac output, and or blood pressure. [9,13,14]

Hajj is the largest annual religious ritual in the world, and also an obligation to be carried out at least once in the lifetime of every physically, psychologically and financially able Muslim.[14] Pilgrims with hyperglycemic should avoid exposure to heat and use protective footwear during hajj rituals. The mass-collection treatment in Hajj can be optimized by increasing the patient's knowledge of performing the pilgrimage at a younger age, doing monitoring of hypertension, blood glucose, and screening of pre-existing comorbidities. Maintaining weight, abdominal circumference, lipid profile within the optimal limit by continuing to perform regular physical activity and consumption of low-calorie foods, high fiber, and do not smoke is needed before pilgrims perform the pilgrimage.

Adherence to antihypertensive and antihyperglycemic consumption is also needed for blood pressure and blood glucose of pilgrims remain controlled before and during the pilgrimage. For healthcare providers it is necessary to immediately formulate regulation for additional history recording of drugs consumed by pilgrims during initial health check prior to departure. In order for the formulation of the drug to be consumed by the congregation appropriately to obtain blood pressure and controlled blood glucose.

**Ethical Clearance:** Ethical clearance and permission of this research was obtained from the Indonesian Ministry of Health with the LB.02.03/1/1429/2018 approval number.

**Conflict of Interest:** All the authors have disclosed no potential conflicts of interest relevant to this article.

**Source of Funding:** source of funding for this research and publishing this article was from Universitas Indonesia.

## REFERENCES

1. K. G. M. M. Alberti *et al.* Harmonizing the metabolic syndrome international atherosclerosis society and international association for the study of obesity. *Circulation.* 2009; 120(16): (1640-1645).
2. M. K. Sharma *et al.* Prevalence of metabolic syndrome in impaired fasting glycemic subjects. *Asian Journal Pharmaceutical Clinical. Research.* 2014; 7 (6): (169–172).
3. H. Ghafouri, S. Saravani, and F. Shokraneh. Burden of circulatory system diseases and ignored barriers of knowledge translation. *Journal of Cardiovascular and Thoraric Research.* 2012; 4 (4): (89–94).
4. Little M.P. Radiation and circulatory disease. *Mutation Research.* 2016; 770: (299–318).
5. E. Mccracken, M. Uk, M. Monaghan, M. Uk, S. Sreenivasan, and F. Edin. Pathophysiology of the metabolic syndrome. *Clinical. Dermatology.* 2018; 36 (1): (14–20).
6. C. H. Orces and E. Lopez. The prevalence of metabolic syndrome among older adults in Ecuador : Results of the SABE survey. *Diabetes Metabolism Syndrome.* 2017; 11: (S555–S560).
7. V. Guarner-lans, M. E. Rubio-ruiz, I. Pérez-torres, G. Baños, and D. Maccarthy. Relation of aging and sex hormones to metabolic syndrome and cardiovascular disease. *Experimental Gerontology.* 2011; 46 (7): (517–523).
8. R. M. Mabry, M. M. Reeves, E. G. Eakin, and N. Owen. Short Report Gender differences in prevalence of the metabolic syndrome in Gulf Cooperation Council Countries : Asystematic review. *Diabetic Medicine.* 2010; 27: (593–597).

9. A. Kautzky-Willer *et al.* Sex-Specific differences in metabolic control, cardiovascular risk, and interventions in patients with type 2 diabetes mellitus. *Gender Medicine*. 2010; 7(6): (571–583).

10. X. Li *et al.* Metabolic syndrome and stroke : A meta-analysis of prospective cohort studies. *Journal Clinical Neuroscience.* 2017; 40: (34–38).

11. G. Georgiopoulos *et al.* Metabolic syndrome, independent of its components, affects adversely cardiovascular morbidity in essential hypertensives. *Atherosclerosis*. 2016; 244: (66–72).

12. J. D. Tune, A. G. Goodwill, D. J. Sassoon, and K. J. Mather. Cardiovascular consequences of metabolic syndrome. *Translational Research: The Journal of Laboratory and Clinical Medicine.* 2017; 183: (57–70).

13. A. Whaley Connell, B. S. Pavey, K. Chaudhary, G. Saab, and J. R. Sowers. Renin-angiotensin-aldosterone system intervention in the cardiometabolic syndrome and cardio-renal protection. *Therapeutic Advances in Cardiovascular Disease.* 2007; 1(1): (27–35).

14. S. M. Razavi, A. Sabouri-kashani, and H. Ziaee-ardakani. Trend of diseases among Iranian pilgrims during five consecutive years based on a Syndromic Surveillance System in Hajj. *Medical Journal of the Islamic of Iran.* 2013; 27(4): (179-185).