PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2018.709.714

Research Article
Association between Metabolic Syndrome Criteria and Lifestyle Category among University Academic Staff in West Java, Indonesia

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Abstract

Background and Objective: Metabolic syndrome (MetS) prevalence is rising globally, especially in the higher educational community, such as university academic staff. The MetS risk factor is unbalanced nutritional intake combined with insufficient physical activity. Therefore, our goal is to examine the effects of gender, age, nutrient intake and physical activity on hypertension, central obesity and hypertriglyceridemia probability as an important component of MetS among university academic staff. **Methodology:** The method of this study was a cross-sectional survey and physical examination of MetS on 210 academic staff from Universitas Padjadjaran, Bandung, Indonesia, in 2017. Body height was measured with a stadiometer. Nutritional status and fat mass were measured with a Tanita Bioimpedance Analyzer (BIA). The nutrition intake analysis applied a repeated 24 h food recall method. Physical activity was assessed using the Young Men's Christian Association (YMCA) step test and Global Physical Activity Questionnaire (GPAQ). Triglyceride level was evaluated by the glycerol-3-phosphate oxidase–phenol aminophenazone (GPO-PAP) method. The data were analyzed with chi-square or Fisher's exact test and a logistic regression test. **Results:** Analysis findings showed a significant association between gender, age and nutritional status, with 72% probability of hypertension; a significant relationship among gender, age, nutritional status, fat mass and physical fitness, with 98% probability of central obesity; and an association among gender, age and physical fitness, with 4.9% probability of hypertriglyceridemia. **Conclusion:** These results suggest that middle-aged males who are more than 35 years old, combined with over-nutritional status, less dietary intake, less physical activity and low physical fitness have a higher risk of developing MetS.

Key words: Central obesity, fat mass, hypertension, hypertriglyceridemia, physical activity, nutritional status

Received: December 04, 2017 Accepted: September 05, 2018 Published: November 15, 2018

Citation: Vita Murniati Tarawan, Siti Nur Fatimah, Titing Nurhayati, Mohammad Rizky Akbar, Putri Teesa Radhiyanti, Ambrosius Purba, Ieva Baniasih Akbar and Hanna Goenawan, 2018. Association between Metabolic Syndrome Criteria and Lifestyle Category among University Academic Staff in West Java, Indonesia. Pak. J. Nutr., 17: 709-714.

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The prevalence of mortality caused by non-communicable diseases continues to increase throughout the world. The World Health Organization (WHO) notes that the death rate from heart disease worldwide is 17.7 million annually. In Indonesia, 37% of deaths are caused by cardiovascular disease. Other non-communicable diseases that cause the most deaths are diabetes and stroke[1]. Controlling the causes and risk factors of these diseases to slow disease progression is essential to decreasing mortality. MetS is one of the conditions that can indicate early heart disease risk. Classifications by the WHO and NCEP ATP III, consisting of central obesity, hypertriglyceridemia and high fasting blood glucose, are the most widely used classifications[1,2,3].

Hypertension, central obesity and hypertriglyceridemia are the primary MetS symptoms in the Indonesian community[3]. The risk factors for MetS are a sedentary lifestyle and smoking. A sedentary lifestyle includes high-calorie intake and low physical activity[2,4]. Various factors associated with metabolic changes, such as nutrients and physical activity, can be common conditions that cause disease. Body fat mass describes the fat composition and can indicate more specific metabolic conditions with nutritional status parameters. Physical fitness describes the physiological and metabolic efficiency capabilities of the body and is associated indirectly with nutritional needs as substrate and organ responses[5].

Central obesity is one of the most straightforward measurements to predict fat deposition, which will increase the risk of insulin resistance and hypertriglyceridemia[6]. Central obesity is also an indirect risk factor for high blood pressure[7]. Obesity affects the capacity of organs, homeostasis and the ability to adapt and it increases the risk of heart disease. Additionally, there are different adaptive responses between men and women[8]. The prevalence of central obesity in Indonesia in 2009 was 18.8% and the prevalence of hypertension in 2013 was 25.8%. The prevalence of hypertriglyceridemia was higher than other risk factors, at 45.5%[2].

Controlling MetS prevalence is essential because MetS can increase morbidity and mortality and decrease work productivity. The manifestation of MetS begins to rise at the end of the productive age; thus, controlling the risk factors for MetS would have a more significant benefit at younger and productive ages. It is important to analyze the MetS risk factors for a productive age group that has a higher level of education, medium to high psychological stress, sedentary daily activities and imbalanced nutrition intake because these are the factors that could increase Mets symptoms.

Currently, there is a lack of information regarding the relationship among nutritional intake, physical activity level and physical fitness with central obesity, hypertension and hypertriglyceridemia in adults and individuals in early adulthood with middle socioeconomic status and higher education. Therefore, this study aims to analyze the relationship among nutritional intake, physical activity levels and fitness with central obesity, hypertension and hypertriglyceridemia in university academic staff.

MATERIALS AND METHODS

The study design was a cross-sectional study with a simple random sampling method to select subjects from the academic staff of the Universitas Padjadjaran Bandung, Indonesia.

In total, 210 participants were included. Inclusion criteria were the academic staff of the Universitas Padjadjaran who agreed to undergo the health examination voluntarily. Exclusion criteria were the heart, joint and muscle diseases and another underlying disease. After the study protocol details were explained, all participants voluntarily signed an informed consent form. This study was approved by the Institutional Ethical Committee of Faculty of Medicine Universitas Padjadjaran (Protocol no POB/12/KEPK-FKUP).

Measurements: Blood pressure was measured by a trained paramedic using mercury sphygmomanometers (Riester, Riester Direct, CA, USA). A venous blood sample was taken from a vein in the cubital fossa after an overnight fast. The blood sample was subjected to triglyceride analysis. The blood sample was analyzed in the Health and Medical Center Laboratory of Universitas Padjadjaran. Triglyceride analysis was performed using a GPO-PAP method that has been described by Khan *et al.*[9]. Height was measured with Microtoise (Seca, Chino, CA, USA). Body weight and body fat percentage were measured with a BGA Impedance Analyzer (Tanita, Arlington Heights, Illinois, USA) type SC 331. Daily physical activity was measured using a Global Physical Activity Questionnaire (WHO). Physical fitness was measured with the Young Men's Christian Association (YMCA) Bench Step Test method. To measure participants' food intake, 24 h dietary recalls method was used for two consecutive days performed by a trained nutritionist.

Statistical analysis: Statistical analysis of the research data was conducted with SPSS 23 software using descriptive and analytical studies (bivariate analysis used a chi-square test and

Fischer's exact test). Multivariate analysis with a logistic regression test was used to assess the correlation of age, fat mass and low physical activity with central obesity risk.

RESULTS

In total, 210 subjects were included in this study. General characteristics of the subjects are presented in Table 1. The number of subjects that participated in this study was almost equal between male and female participants. More than half of the participants were older than 35 years old, as shown in Table 1. Table 2 shows the central obesity, blood pressure and lipid profile of the subjects. More than 80% of the participants were overweight, with fat measurements showing that 74% of the participants were overfat. Approximately 80% of the participants had high sodium and calcium intake. Conversely, the physical activity and physical fitness of the participants were deficient (Table 3).

Bivariate analysis of factors related to hypertension in this study is presented in Table 4. The analysis results showed that there is a relationship between sex, age group and nutritional status with normal blood pressure and hypertension.

The results of a logistic regression test that measured the correlation of gender, age and nutritional status are presented in Table 5. Multivariate analysis of environmental factors with hypertension (Table 5) showed that male gender, age less than 35 years and healthy nutritional status have a 72% probability of developing hypertension.

Bivariate analysis of factors related to central obesity is presented in Table 6. The results of the study show that there is a relationship between sex, age group, nutritional status, fat mass and fitness with normal weight and central obesity.

Table 1: General characteristics of subjects

Variables	Frequency	Percentage
Total subjects	210	
Gender		
Male	107	50.7
Female	103	49.3
Age		
<35 years old	38	18
>35 years old	172	82

Table 2: Central obesity, blood pressure and lipid profile of subjects

Variables	Frequency	Percentage
Waist circumference		
Normal	123	58.3
Central obesity	87	41.7
Blood pressure		
Normal	131	62.4
Hypertension	79	37.9
Triglyceride level		
Normal	154	73.3
Hypertriglyceridemia	56	30.5

Multivariate analysis of environmental factors with central obesity (Table 7) used a logistic regression test to measure the correlation among gender, age, nutritional status, fat mass and

Table 3: Nutritional, physical activity and physical fitness characteristics of the subjects

Variables	Frequency	Percentage
Nutritional status		
Normal	40	19
Overweight/obese	170	81.1
Fat mass		
Underfat and normal	53	25.1
Overfat	157	74.9
Total calorie intake		
Low and normal	207	98.1
High	3	1.9
Calcium intake		
Low and normal	203	96.2
High	7	3.8
Sodium intake		
Low and normal	172	81.5
High	38	18.5
Physical activity		
Low	191	90.5
Normal	19	9.5
Physical fitness		
Low	161	76.3
Good and high	49	23.7

Table 4: Correlation of environmental factors and blood pressure

			95% CI	
Variables	p	OR	Min.	Max.
Gender				
Male	0.04*	0.55	0.31	0.97
Female				
Age				
<35 years old	0.02*	4.02	1.6	10.1
>35 years old				
Nutritional status				
Normal	0.02*	2.47	1.8	5.1
Overweight and obese				
Total calorie				
Low and normal	0.55**	3.3	0.29	37.1
High				
Calcium intake				
Low and normal	0.26**	0.26	0.31	2.21
High				
Sodium intake				
Low and normal	0.57*	1.22	0.61	2.5
High				
Fat mass				
Underfat and normal	0.1*	1.74	0.88	3.43
Overfat				
Physical activity				
Low	0.54*	0.73	0.26	2.0
Normal				
Physical fitness				
Low	0.92*	0.96	0.49	1.88
Normal				

*Chi-square, **Fisher's exact, Min: Minimum, Max: Maximum

Table 5: Multivariate analysis of environmental factors and hypertension

Variables	Coefficient	P	OR	95% CI
Male	0.62	0.03	1.86	1.03-3.33
Age less than 35 years old	-1.31	0.00	0.27	0.10-0.69
Normal nutritional status	-0.75	0.07	0.46	0.20-1.07
Constant	0.49	0.03		

Table 6: Correlation of environmental factors and central obesity

			95% CI	
Variables	P	OR	Min.	Max.
Gender				
Male	0*	12.09	6.42	24.8
Female				
Age				
<35 years old	0.08*	1.94	0.9	4.16
>35 years old				
Nutritional status				
Normal	0.02*	3.47	1.51	7.97
Overweight and obese				
Total calorie intake				
Low and normal	0.57**	2.87	0.25	3.16
High				
Fat mass				
Underfat and normal	0*	3.58	1.72	7.46
Overfat				
Physical activity				
Low	0.12*	2.08	0.8	5.4
Normal				
Physical fitness				
Low	0.01	0.38	0.18	0.79
Good				

*Chi-square, **Fisher's exact, Min: Minimum, Max: Maximum

Table 7: Multivariate analysis of environmental with central obesity

Variables	Coefficient	P	OR	95% CI
Male	-2.96	0.00***	0.52	0.24-0.11
Age less than 35 y.o.	-0.94	0.5	0.39	0.15-1.01
Normal fat mass	-1.82	0.00***	0.16	0.65-0.40
Low physical fitness	0.91	0.04	2.50	1.0-6.2
Constant	0.87	0.06		

physical fitness. The results suggest that individuals with age less than 35 years old, normal fat mass and low physical fitness had a 98% chance of developing central obesity in the future.

Bivariate analysis of factors associated with hypertriglyceridemia in this study is presented in Table 8. The results showed that there was a relationship between sex, age group and nutritional status with hypertriglyceridemia.

Multivariate analysis of environmental factors with hypertriglyceridemia (Table 9) showed that male gender, age less than 35 years old and low physical fitness had a 4.9% risk of developing hypertriglyceridemia.

Table 8: Correlation of environmental factors with hypertriglyceridemia

			95% CI	
Variables	P	RO	Min.	Max.
Gender				
Male	0.00*	0.34	0.17	0.66
Female				
Age				
<35 years old	0.03*	2.78	1.02	7.53
>35 years old				
Nutritional status				
Normal	0.06*	2.36	0.93	5.97
Overweight and obese				
Total calorie intake				
Low and normal	1.0**	1.38	0.12	15.54
High				
Fat mass				
Underfat and normal	0.44*	1.33	0.64	2.76
Overfat				
Physical activity				
Low	0.97*	0.98	0.33	2.85
Normal				
Physical fitness				
Low	0.15*	0.56	0.25	1.25
Good				

Table 9: Multivariate analysis of environmental factors with hypertriglyceridemia

Variables	Coefficient	P	OR	95% CI
Male	1.15	0.00	3.17	1.62-6.21
Age less than 35 years old	-1.19	0.02	0.30	0.10-0.85
Low physical fitness	0.82	0.05	2.27	0.98-5.26
Constant	2.20	0.00		

DISCUSSION

This study aims to analyze various factors that contribute to an increased risk of MetS symptoms in the age groups less than 35 years and over 35 years. Subjects with a high risk of MetS had the following characteristics: age more than 35 years, overweight and obese, low nutrient intake, low physical activity and low physical fitness. This result confirmed the result of a previous study about lipid profiles and lifestyle changes during middle age. Increasing age in males contributed to increasing LDL and total cholesterol levels[4,7].

With age greater than 35 years, the fat mass and the metabolic process will gradually decrease. A multicenter survey on risk factors for coronary heart disease in Europe in 2015 states that people do not receive accurate information on lifestyle guidelines, such as maintaining a healthy nutritional status and adequate physical activity; these factors are risks for hypertension and its complications[10].

A cohort study of adult and elderly groups in the United States in 2015 analyzed the frequency of metabolically healthy changes to metabolically unhealthy by taking into account environmental factors; the results suggest that central obesity

is a metabolic condition of transition and will increase to degenerative diseases at a later age[11]. In the current study, low physical fitness is an essential factor that increases the metabolic syndrome risk factor. The similar results were found in other countries, such as Korea and Brazil[12,13].

Fat mass increases with increasing age. However, the spread of fat is different in men and women. The risk of disease varies, as demonstrated by various research results[14]. Another study found that metabolically unhealthy conditions were higher in an abdominal obesity group[6] .Some animal studies found that obesity induces inflammation via the PPAR gamma pathway and results in insulin resistance[15,16].

Analysis of relevant environmental risk factors was undertaken; Hulsegge's survey found that with increasing obesity, it is predicted that younger generations now have a higher risk of metabolic abnormalities than previous generations[17].

A review of the Asia Pacific Cohort Study Collaboration demonstrates that the control of metabolic risks, such as blood pressure, blood sugar and serum cholesterol, is associated with a reduced risk of cardiovascular disease[18].

The control of risk factors for non-communicable diseases, in general, is preferable, with collective recommendations of various environmental factors, such as healthier dietary intake and healthy behaviors, including increased physical activity[19]. The combination of abdominal obesity with physical inactivity is the most important risk factor for heart disease and other noncommunicable diseases[20].

Maintaining the composition of muscle mass becomes metabolically better by improving fitness and weight loss in women[21]. Increasing physical fitness by high-intensity exercise training can lower blood pressure by reducing total peripheral resistance[22]. Long-term aerobic exercise showed a significant reduction in insulin resistance in older adults[23].

Physical inactivity has become a serious issue worldwide, especially in Indonesia. The same problem occurred in other Southeast Asian countries. A study revealed that children and youth in Thailand had low physical activity[24]. The decrease in physical activity is correlated with increasing age. This problem was also found in Malaysia. A majority of children and adolescents have a low physical level that is correlated with active commuting, extended screen time and nutritional imbalance[25].

Therefore, increasing physical activity on a daily basis is needed to reduce the risk of MetS. Some education programs and policies should be applied to increase the physical activity of academic staff.

It is unfortunate that this study did not include data about the diseases that the subjects already had and the drugs that the subjects consumed. It would be interesting to analyze the diseases that the subjects had and the risk of developing Mets. Another limitation of this study was the lack of information about the subjects' smoking habits, transportation, screen time and sodium intake. Further investigation is needed to analyze the correlation of MetS and nutritional and behavioral factors.

CONCLUSION

In conclusion, middle-aged males who are more than 35 years old and who have over-nutritional status, low dietary intake, low physical activity and low physical fitness have a higher risk of developing MetS. Thus, increasing physical activity and balancing nutritional intake are needed to prevent MetS in the future.

SIGNIFICANCE STATEMENT

This study discovered the primary risk factor for metabolic syndrome that can be beneficial for an education and prevention program. People with higher education have a lower risk of metabolic syndrome. However, in Indonesia, higher education is not correlated with metabolic syndrome risk factors. We find that the main risk factor that corresponds with metabolic syndrome in Indonesian academic staff is low physical activity. This study will help researchers uncover the critical areas of Indonesian behavior that lead to the correlation of physical inactivity with MetS risk rather than education level that many researchers were not able to explore. Thus, a new theory on cultural influence on physical inactivity may be ascertained.

ACKNOWLEDGMENTS

The authors wish to thank staff members of Universitas Padjadjaran for assistance in data collection and valuable advice during the survey. This study was conducted with the support of the Academic Leadership Grant (ALG) Universitas Padjadjaran from the Indonesian Ministry of Higher Education No 1-1-6 to IB Akbar.

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