Original Article

Association of Cigarette Smoking and Metabolic Syndrome among Heavy Smokers in Thailand

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Objective: To determine the association between metabolic syndrome as defined by the modified NCEP/ATP III criteria and cigarette smoking among Thai smokers aged 50 years or older.

Materials and Methods: Cross-sectional data were collected from 679 smokers and former smokers in a lung cancer screening program in Thailand between 2015 and 2017. Participants were interviewed and examined for weight, height, blood pressure, lipid profile, and fasting glucose concentration. Logistic regression models were used to estimate odds ratios [ORs] and 95% confidence intervals [CI].

Results: Metabolic syndrome was found in 49.0% of participants. Smoking status was statistically significantly related to metabolic syndrome (p-value = 0.001). Among non-metabolic syndrome participants, 46.5% were former smokers and 53.5% were current smokers, compared with 60.0% former smokers and 40.0% current smokers among participants with metabolic syndrome. Reduced odds of being current smokers (vs. former smokers) were found for those with metabolic syndrome, higher BMI, and high blood pressure. Metabolic syndrome and its components were associated with current smoking levels among active smokers, with statistically significant effects found for high fasting plasma glucose (OR = 1.66; 95% CI: 1.03 to 2.67; p-value = 0.039) and high triglycerides (OR = 1.75; 95% CI: 1.07 to 2.85; p-value = 0.026). After adjusting for possible confounders, those with high fasting plasma glucose were 1.73 times more likely (95% CI: 1.02 to 2.93, p-value = 0.042) and those with high triglycerides were 2.97 times more likely (95% CI: 1.43 to 6.13, p-value = 0.003) to currently smoke more than 10 cigarettes per day, compared with currently smoking 10 or less cigarettes per day. However, there was a significant negative relationship between low HDL cholesterol level and smoking more than 10 cigarettes per day (OR = 0.48; 95% CI: 0.24 to 0.97; p-value = 0.041).

Conclusion: Current smokers could be at high risk for developing metabolic syndrome. Those smoking more than 10 cigarettes a day have higher level of fasting plasma glucose and triglyceride . However, low HDL cholesterol levels are more common among those smoking 10 or less cigarettes per day.

Keywords: Metabolic syndrome, Cigarette smoking, Current smoking, Heavy smokers, Lung cancer screening

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Metabolic syndrome, a condition characterized by abdominal obesity, dyslipidemia, elevated blood pressure, and hyperglycemia, has become one of the major public health challenges worldwide[1]. This syndrome increases the risk of developing type 2 diabetes and cardiovascular disease and is correlated with all-cause mortality[2,3]. Additionally, accumulating evidence supports the notion that metabolic syndrome is linked to various types of malignancies[4,5]. It is estimated that around 20% to 25% of the world's adult population have metabolic syndrome, and these

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individuals are twice as likely to die and three times more likely to have a heart attack or a stroke, compared with those without the syndrome[6].

The relationship between metabolic syndrome and smoking has been studied for many years, with most findings indicating that smoking is an important cause of morbidity and mortality, worldwide[7]. Earlier studies have suggested that overall tobacco use is associated with an increased risk of metabolic syndrome, most likely because of the effect of tobacco use on waist circumference, lipids, and blood pressure. Such metabolic abnormalities may also be modulated by the direct negative effect of smoking on insulin resistance. Smoking has been reported to lower high-density lipoprotein cholesterol [HDL-C] and to increase both low-density lipoprotein cholesterol [LDL-C] and triglycerides[8,9].

In Korea, the prevalence of metabolic syndrome in sustained smokers was found to be 14%[10]. Studies in Taiwan and in Korea have showed a higher prevalence of metabolic syndrome in smokers than in those who have never smoked, and current smoking had a significant dose-dependent association with metabolic syndrome[11,12]. A positive relationship has been observed between cigarette smoking and metabolic syndrome among Thais (OR = 1.4), and the prevalence of metabolic syndrome has been reported as 19% among male smokers who did not drink[13]. In a normal population aged 15 years and over, the prevalence of metabolic syndrome was found to be 20.0%[14]. The present study aimed to determine the interaction between metabolic syndrome and cigarette smoking among moderate-to-heavy smokers in Thailand.

Materials and Methods

Participants

The Lung Cancer Screening Program is a prospective population-based cohort study conducted at Chulabhorn Hospital to examine lung cancer screening and the health effects of heavy smoking in Thailand. The screening employs a wide range of procedures to assess lung screening, along with radiological, biological, sociodemographic, behavioral, physical, and psychological factors contributing to health and lung disease among heavy smokers.

This cross-sectional study included 679 Thai current and former smokers aged 50 years or older who participated in the third-year follow-up of the Lung Cancer Screening Program between May 2015 and February 2017. All participants completed an interview and were examined for weight, height, blood pressure, and biological results of a lipid profile and fasting glucose concentration.

Smoking habits

Information was collected on participants' smoking habits. They were considered current smokers if they reported having smoked at least 100 cigarettes during their lifetime and were still smoking[5]. Information on daily cigarette consumption was used to define the amount of cigarette smoking per day (1 to 9, 10 to 19, 20 cigarettes or more) among current smokers. Former smokers were defined as those who had smoked at least 100 cigarettes during their lifetime and had stopped smoking. Three types of smokers were considered, light smokers, who smoked less than 15 packs per year [PY], moderate smokers, who smoked 15 to 29 packs PY, and heavy smokers, who smoked at least 30 packs PY[15]. Packs smoked PY was calculated as the number of cigarettes smoked per day times years of smoking divided by 20[16].

Assessment of metabolic syndrome

For metabolic syndrome, the modified National Cholesterol Education Program's Adult Treatment Panel III (NCEP/ATP III)[6] requires the presence of three or more of the following characteristics, (1) abdominal obesity (waist circumference greater than 90 cm in men or greater than 80 cm in women, or BMI greater 25 kg/m^2 in men or greater than 23 kg/m^2 in women for Asian populations); (2) high triglyceride level (150 mg/dl or more); (3) low HDL-C level (less than 40 mg/dl for men or less than 50 mg/dl for women); (4) high blood pressure (systolic at 130 mmHg or greater or diastolic at 85 mmHg or greater); and (5) high fasting plasma glucose concentration 010 mg/dl or more). Individuals were considered to have met the criteria for high fasting plasma glucose concentration and high blood pressure if they currently took blood pressure medications or oral hypoglycemic diabetes mellitus control. Individuals with a previous physician's diagnosis of hypertension or diabetes mellitus who did not report medication use were classified as having metabolic syndrome, and a similar approach was taken with the dyslipidemia criteria. The measurements were based on the NCEP/ATP III criteria using an Asian reference for the interpretation of BMI.

Statistical analysis

The data are presented as the characteristics

and prevalence of metabolic syndrome among the full sample. Individuals with and without metabolic syndrome were compared to determine the associations among all investigated variables using Fisher's exact test. These analyses included the examination of metabolic syndrome and its components as predictors of smoking status and level of cigarette consumption among current smokers using logistic regression. These models were adjusted for age, education, income, alcohol consumption, physical activity, packs of cigarettes smoked per year, BMI, high fasting glucose, high triglycerides, low HDL-C, and blood pressure. The level of statistical significance was set at *p*-value smaller than 0.05 for all tests. The statistical analyses were performed using Stata/SE version 12.1 (StataCorp, College Station, Texas).

The protocol of this research was reviewed and approved by the Human Research Ethics Committee, Chulabhorn Research Institute No. 004/2559.

Results

Six hundred seventy-nine participants were included in the study, with a high prevalence of metabolic syndrome (49.0%) (Table 1). For the comparison of age, sex, education, monthly income, alcohol consumption, physical activity, smoking status, and packs smoked per year by the criteria values of metabolic syndrome diagnosis, the sample was divided into two subsamples, non-metabolic syndrome [NMBS] and metabolic syndrome [MBS], as shown in Table 2. Smoking status was significant ($p = 0.001$). Among the NMBS group, 46.5% were former smokers and 53.5% were current smokers. This is compared with 60.0% former smokers and 40.0% current smokers among the MBS group.

Table 3 displays the odds ratios [ORs] for metabolic syndrome and its components predicting smoking status (former smokers vs. current smokers). There were negatively statistically significant relationships between current smoking and metabolic syndrome (OR = 0.58; 95% CI: 0.43 to 0.78; *p*-value <0.001), BMI (OR = 0.61; 95% CI: 0.44 to 0.85; *p*-value = 0.004), and high blood pressure (OR = 0.57; 95% CI: 0.42 to 0.78; *p*-value <0.001). After adjusting the odds ratios for covariates, significant effects were found for metabolic syndrome (OR = 0.56; 95% CI: 0.41 to 0.77; *p*-value <0.001), BMI (OR = 0.62; 95% CI: 0.43 to 0.89; *p*-value = 0.010), and high blood pressure (OR = 0.64; 95% CI: 0.46 to 0.91; *p*-value = 0.012). No significant difference was observed in the occurrence of metabolic syndrome.

The ORs of metabolic syndrome and its components predicting the level of cigarette smoking among current smokers are shown in Table 4. Statistically significant relationships were found for high fasting plasma glucose (OR = 1.66; 95% CI: 1.03 to 2.67; $p = 0.039$) and high triglycerides levels (OR = 1.75 (95% CI: 1.07 to 2.85; $p = 0.026$). Analyses were conducted with adjustments for various possible confounders. After this adjustment, the odds of smoking more than 10 cigarettes per day were significantly greater among those with high triglycerides (OR = 2.97; 95% CI: 1.43 to 6.13; $p = 0.003$), and there was little change in effect for high fasting plasma glucose (OR = 1.73; 95% CI: 1.02 to 2.93; $p = 0.042$). Moreover, there was a negatively statistically significant effect for low HDL-C (OR = 0.48; 95% CI: 0.24 to 0.97; $p = 0.041$).

Discussion

The present study has demonstrated the prevalence of metabolic syndrome among smokers in Thailand who participated in the Lung Cancer Screening Program, a cohort study at Chulabhorn Hospital. The present findings show a higher prevalence than those observed in other populations in previous studies[11,13,14]. The prevalence was higher because of age and smoking status. This study also examined the relationship between metabolic syndrome and smoking status. Those with metabolic syndrome had higher odds

Table 1. Prevalence of metabolic syndrome (n = 679)

Characteristic	Total (n = 679)
BMI ≥25 kg/m^2 (men) or ≥23 kg/m^2 (women)	224 (33.0%)
FBS ≥100 mg/dl	317 (46.7%)
Triglyceride level ≥150 mg/dl	397 (58.5%)
HDL cholesterol level <40 mg/dl (men) or <50 mg/dl (women)	328 (48.3%)
Blood pressure: S <130 and/or D <85 mmHg	380 (56.0%)
Metabolic syndrome	333 (49.0%)

Table 2. Criteria values for metabolic syndrome (MBS) diagnosis, age, sex, education, income/month, alcohol consumption, physical activity, smoking status, and packs smoked/year in two subsamples (MBS vs. NMBS)

Variable (BMI)	Total	NMBS (n = 346)	MBS (n = 333)	*p*-value
Age (years)	61.9±5.3	61.6±5.3	62.3±5.4	0.115
Men (n)	637 (93.8%)	326 (94.2%)	311 (93.4%)	0.750
Education				0.355
Primary school	138 (20.3%)	67 (19.4%)	71 (21.3%)	
High school	140 (20.6%)	80 (23.1%)	60 (18.0%)	
Diploma	146 (21.5%)	69 (19.9%)	77 (23.1%)	
Bachelor's degree or above	255 (37.6%)	130 (37.6%)	125 (37.5%)	
Income/month				0.282
<15,000 baht	261 (38.4%)	143 (41.3%)	118 (35.4%)	
15,000 to 29,999 baht	177 (26.1%)	87 (25.1%)	90 (27.0%)	
≥29,999 baht	241 (35.5%)	116 (33.5%)	125 (37.5%)	
Alcohol consumption				0.202
Nondrinker	205 (30.2%)	114 (32.9%)	91 (27.3%)	
Former drinker	151 (22.2%)	78 (22.5%)	73 (21.9%)	
Current drinker	323 (47.6%)	154 (44.5%)	169 (50.7%)	
Physical activity				0.784
None	382 (56.3%)	191 (55.2%)	191 (57.4%)	
<3 times/week	68 (10.0%)	34 (9.8%)	34 (10.2%)	
≥3 times/week	229 (33.7%)	121 (35.0%)	108 (32.4%)	
Smoking status				0.001*
Former smoker	361 (53.2%)	161 (46.5%)	200 (60.0%)	
Current smoker	318 (46.8%)	185 (53.5%)	133 (40.0%)	
Packs of cigarettes smoked/year	39.9±13.5	39.9±13.1	39.9±13.9	0.998

Data are presented as mean ± SD or n (%), * $p<0.05$

Table 3. Odds ratios [ORs] of metabolic syndrome and its components predicting smoking status

Variable	Former smoker	Current smoker			
		OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
Metabolic syndrome	1	0.58 (0.43 to 0.78)	<0.001	0.56 (0.41 to 0.77)	<0.001
BMI	1	0.61 (0.44 to 0.85)	0.004	0.62 (0.43 to 0.89)	0.010
High fasting glucose	1	0.94 (0.70 to 1.27)	0.704	1.05 (0.75 to 1.47)	0.771
High triglycerides	1	0.79 (0.58 to 1.07)	0.121	0.75 (0.48 to 1.16)	0.195
Low HDL cholesterol	1	0.85 (0.63 to 1.16)	0.309	1.20 (0.78 to 1.85)	0.412
High blood pressure	1	0.57 (0.42 to 0.78)	<0.001	0.64 (0.46 to 0.91)	0.012

Adjusted for age, education, income, alcohol consumption, physical activity, packs of cigarettes smoked/year, BMI, high fasting glucose, high triglycerides, low HDL cholesterol, and blood pressure

of being former smokers than of being current smokers. The findings were consistent with the general idea that current smokers have lower anthropometric indexes than do former smokers[17]. Several studies have shown that individuals who quit smoking tended to increase their body weight[18]. Additionally, metabolic syndrome has previously been found to be more prevalent in former smokers (48.4%), compared with active smokers (42.7%) and non-smokers (40.0%)[5]. After smoking cessation, the OR of metabolic syndrome has been

Table 4. Odds ratios (ORs) of metabolic syndrome and its components predicting smoking levels among active smokers

Variable	≤10 cigarettes/day	>10 cigarettes/day			
		ORs (95% CI)	*p*-value	Adjusted ORs (95% CI)	*p*-value
Metabolic syndrome	1	1.17 (0.72 to 1.89)	0.524	1.09 (0.66 to 1.81)	0.723
BMI	1	1.07 (0.63 to 1.82)	0.804	0.89 (0.48 to 91.65)	0.706
High fasting glucose	1	1.66 (1.03 to 2.67)	0.039	1.73 (1.02 to 2.93)	0.042
High triglycerides	1	1.75 (1.07 to 2.85)	0.026	2.97 (1.43 to 6.13)	0.003
Low HDL cholesterol	1	1.01 (0.63 to 1.63)	0.954	0.48 (0.24 to 0.97)	0.041
High blood pressure	1	1.11 (0.69 to 1.78)	0.672	1.11 (0.63 to 1.93)	0.717

Adjusted for age, education, income, alcohol consumption, physical activity, BMI, packs smoked/year, blood pressure, high fasting glucose, high triglycerides, and low HDL cholesterol

found to increase to 1.36 (95% CI: 1.16 to 1.60); this was highest in the first five years after smoking cessation, and subjects who smoked 20 cigarettes per day or more before cessation had an increased risk of metabolic syndrome for the next 20 years[19]. Current smoking has been shown to be mainly associated with lower levels of HDL-C and higher levels of triglycerides[20].

In the present study, high fasting plasma glucose and high triglycerides levels were higher among those currently smoking more than 10 cigarettes per day. These findings are consistent with several previous studies that found a positive association between smoking and subsequent risk of diabetes[21-23]. We also found an increased risk of high triglyceride level in current smokers[13,24,25]. Nonetheless, in the covariate-adjusted analysis, current smokers consuming more than 10 cigarettes per day were 1.73 and 2.97 times more likely to have high fasting plasma glucose and high triglycerides levels, respectively, compared with current smokers of fewer than 10 cigarettes per day. Plasma triglyceride concentrations were positively correlated with cigarette smoking[26], and a lower level of HDL-C was found among current smokers consuming more 10 cigarettes per day. These findings were consistent with previous studies that found a negative association between smoking and levels of HDL-C[11,27,28].

The present study had some limitations. First, the selected sample meeting the inclusion criteria were 679 of a total of 787 participants in the Lung Cancer Screening Program. All participants smoked or had a history of smoking and were older individuals. Second, the small number of women who smoke limited statistical power and the ability to detect sex differences the study outcomes. Individual components of metabolic syndrome were assessed in terms of treatment history, drugs used, and laboratory tests, which are strengths of this study. This study has demonstrated that smoking has substantial negative health consequences.

Conclusion

Smoking is associated with metabolic syndrome, especially among heavy smokers who currently smoke more than 10 cigarettes per day, who have an increased risk of developing metabolic syndrome with high fasting plasma glucose and high triglyceride levels.

What is already known on this topic?

The prevalence of metabolic syndrome and the relationship of smoking with metabolic syndrome were already known. The results of this study revealed the prevalence of metabolic syndrome and the relationship of smoking to metabolic syndrome among participants in an integrated lung cancer screening program.

What this study adds?

The study adds information, raising the awareness of the dangers of smoking that affect long-term health and providing data to support the prevention of chronic disease [NCD], a public health policy in Thailand.

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Potential conflicts of interest

Lung cancer screening program in Chulabhorn hospital under HRH Princess Chulabhorn College of Medical Science.

References

1. Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. Circulation 2009; 120: 1640-5.
2. Wilson PW, D'Agostino RB, Parise H, Sullivan L, Meigs JB. Metabolic syndrome as a precursor of cardiovascular disease and type 2 diabetes mellitus. Circulation 2005; 112: 3066-72.
3. Lakka HM, Laaksonen DE, Lakka TA, Niskanen LK, Kumpusalo E, Tuomilehto J, et al. The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. JAMA 2002; 288: 2709-16.
4. Pothiwala P, Jain SK, Yaturu S. Metabolic syndrome and cancer. Metab Syndr Relat Disord 2009; 7: 279-88.
5. Calo WA, Ortiz AP, Suarez E, Guzman M, Perez CM, Perez CM. Association of cigarette smoking and metabolic syndrome in a Puerto Rican adult population. J Immigr Minor Health 2013; 15: 810-6.
6. 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.
7. World Health Organization. [Internet]. Copenhagen, Denmark: WHO; 2011 [cited 2012 Sep 23]. Available from: http://www.who.int/tobacco/health_priority/en/.
8. Batsis JA, Nieto-Martinez RE, Lopez-Jimenez F. Metabolic syndrome: from global epidemiology to individualized medicine. Clin Pharmacol Ther 2007; 82: 509-24.
9. Lee WY, Jung CH, Park JS, Rhee EJ, Kim SW. Effects of smoking, alcohol, exercise, education, and family history on the metabolic syndrome as defined by the ATP III. Diabetes Res Clin Pract 2005; 67: 70-7.
10. Kim BJ, Kim BS, Sung KC, Kang JH, Lee MH, Park JR. Association of smoking status, weight change, and incident metabolic syndrome in men: a 3-year follow-up study. Diabetes Care 2009; 32: 1314-6.
11. Chen CC, Li TC, Chang PC, Liu CS, Lin WY, Wu MT, et al. Association among cigarette smoking, metabolic syndrome, and its individual components: the metabolic syndrome study in Taiwan. Metabolism 2008; 57: 544-8.
12. Oh SW, Yoon YS, Lee ES, Kim WK, Park C, Lee S, et al. Association between cigarette smoking and metabolic syndrome: the Korea National Health and Nutrition Examination Survey. Diabetes Care 2005; 28: 2064-6.
13. Suriyaprom K, Namjuntra P, Thawnasom K, Pimainok Y, Tungtrongchitr R. Association between cigarette smoking and metabolic syndrome in Thais. Int J Health Res 2010; 3: 205-12.
14. Santibhavank P. Prevalence of metabolic syndrome in Nakhon Sawan population. J Med Assoc Thai 2007; 90: 1109-15.
15. Gu D, Reynolds K, Wu X, Chen J, Duan X, Reynolds RF, et al. Prevalence of the metabolic syndrome and overweight among adults in China. Lancet 2005; 365: 1398-405.
16. Li Y, Swensen SJ, Karabekmez LG, Marks RS, Stoddard SM, Jiang R, et al. Effect of emphysema on lung cancer risk in smokers: a computed tomography-based assessment. Cancer Prev Res (Phila) 2011; 4: 43-50.
17. Ferrara CM, Kumar M, Nicklas B, McCrone S, Goldberg AP. Weight gain and adipose tissue metabolism after smoking cessation in women. Int J Obes Relat Metab Disord 2001; 25: 1322-6.
18. Filozof C, Fernandez Pinilla MC, Fernandez-Cruz A. Smoking cessation and weight gain. Obes Rev 2004; 5: 95-103.
19. Wada T, Urashima M, Fukumoto T. Risk of metabolic syndrome persists twenty years after the cessation of smoking. Intern Med 2007; 46: 1079-82.
20. Slagter SN, van Vliet-Ostaptchouk JV, Vonk JM, Boezen HM, Dullaart RP, Kobold AC, et al. Associations between smoking, components of metabolic syndrome and lipoprotein particle size. BMC Med 2013; 11: 195.
21. Rimm EB, Chan J, Stampfer MJ, Colditz GA, Willett WC. Prospective study of cigarette smoking,

alcohol use, and the risk of diabetes in men. BMJ 1995; 310: 555-9.
22. Feskens EJ, Kromhout D. Cardiovascular risk factors and the 25-year incidence of diabetes mellitus in middle-aged men. The Zutphen Study. Am J Epidemiol 1989; 130: 1101-8.
23. Haglin LM, Tornkvist B, Backman LO. High serum phosphate and triglyceride levels in smoking women and men with CVD risk and type 2 diabetes. Diabetol Metab Syndr 2014; 6: 39.
24. Willett W, Hennekens CH, Castelli W, Rosner B, Evans D, Taylor J, et al. Effects of cigarette smoking on fasting triglyceride, total cholesterol, and HDL-cholesterol in women. Am Heart J 1983; 105: 417-21.
25. Simons LA, Simons J, Jones AS. The interactions of body weight, age, cigarette smoking and hormone usage with blood pressure and plasma lipids in an Australian community. Aust N Z J Med 1984; 14: 215-21.
26. Kolovou GD, Kolovou V, Mavrogeni S. Cigarette smoking/cessation and metabolic syndrome. Clin Lipidol 2016; 11: 6-14.
27. Cena H, Tesone A, Niniano R, Cerveri I, Roggi C, Turconi G. Prevalence rate of Metabolic Syndrome in a group of light and heavy smokers. Diabetol Metab Syndr 2013; 5: 28.
28. Lee YA, Kang SG, Song SW, Rho JS, Kim EK. Association between metabolic syndrome, smoking status and coronary artery calcification. PLoS One 2015; 10: e0122430.