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Smoking and cardiac risk index in areas with different levels of urban compactness

Demara Yedhi Azlia[1]*, M. Lutfan Lazuardi[2], Arta Farmawati[3], Muhammad Sani Rochyansyah[4]

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[1-4] with the Universitas Gadjah Mada

[1-3] Faculty of Medicine, Public Health, and Nursing

[1] Medical Study Program,
[2] Department of Health Policy and Management,
[3] Department of Biochemistry,
[4] Department of Architecture and Planning, Faculty of Engineering.

*Correspondence:
demarayedhiazlia@gmail.com

Abstract

Purpose: To determine the relationship between urban compactness level, smoking habit, and CRI in Yogyakarta Urban Agglomeration (YUA) region population. **Method:** This cross-sectional study used secondary data from 181 male subjects aged 24-52 years in the YUA region. The chi-square test analyzed the relationship. **Results:** The relationship between urban compactness level and smoking habits showed a value of p=0.075, and the relationship between urban compactness and CRI showed a value of p=0.181. On the other hand, the relationship between smoking habits with CRI showed a value of p=0.008. **Conclusion:** Smoking habit is associated with CRI in the YUA area population. However, a significant relationship is neither found between the level of urban compactness with smoking habit nor CRI.

Keywords: smoking habit; Cardiac Risk Index; urban compactness

INTRODUCTION

Increasing population density will trigger various urban problems, such as pollution, slums, congestion, crime, and poverty (1). The multiple issues in the city will undoubtedly impact the public health level. For this reason, today's city planning is directed to become a compact city model, which is believed to solve various city problems. According to Prativi, cities are the center of activity and economy of a region, with the primary function of providing housing for the community (2). The compact city is a city planning concept with a relatively high density. It uses diverse roles based on an efficient public transportation system that encourages people to walk and cycle (3). The concept of urban planning has implications for forming healthy cities (4). Healthy cities themselves are an approach to improving public health by encouraging the creation of environmental, physical, and social qualities following the needs of urban areas (5). This hope seems unable to be realized yet. A previous study shows that the compactness of the Yogyakarta Urban Agglomeration (YUA) area, following city compactness, is inversely proportional to health status, as measured by healthy city variables (2).

People living in areas with different levels of urban compactness may have different lifestyles, such as eating, exercising, and smoking, which determine their health level. The smoking habit is a problem that is becoming a primary concern in Indonesia and even the world. Indonesia is one of the countries with a high smoking prevalence in Southeast Asia, 35.7% (6,7). The 2013 Basic Health Research showed an increase in the prevalence of smokers in Indonesia (8). The majority of smokers in Yogyakarta City, one of Indonesia's dense cities, also increased from 21% in 2007 to 21.9% in 2013 (8). The high prevalence of smokers in Indonesia is associated with early exposure to smoking due to environmental factors (9).

Smoking has long been recognized as a risk factor for cardiovascular disease (10,11) due to high exposure to free radicals in the body from cigarette smoke (12). The CRI (Cardiac Risk Index) represents a risk of

cardiovascular disease that can be determined by calculating the ratio of Low-Density Lipoprotein (LDL)/High-Density Lipoprotein (HDL) cholesterol levels. This LDL/HDL cholesterol level ratio is a better predictor than normal lipid parameters (13). The LDL/HDL cholesterol levels ratio was significantly higher in smokers than in non-smokers. The increase in this ratio is directly proportional to the occurrence of coronary heart disease (14). Smoking habits and CRI are determinant factors for cardiovascular disease, so it is essential to know and control them.

This study mainly assessed the relationship between smoking habits (smoking and non-smoking categories), CRI (low, medium, and high categories), and the level of urban compactness (low, medium, and high categories) of 24-52 years old males living in the YUA area. Other studies have been conducted, but none has examined those topics specifically, mainly considering specific physical living conditions in urban areas. It might also be an effective initial means to promote and educate healthy living, combining spatial characteristics and people's activity inside.

Through this research, we examined how the relationship between urban compactness, smoking habits, and CRI of the community in the YUA area. This research is expected to benefit city stakeholders, especially the government, in urban development planning related to public health.

METHODS

This research is a cross-sectional study. This study uses secondary data from "Development of a Healthy Compact City Model Based on Individual Health Performance in the Yogyakarta Urban Agglomeration Area" with 286 research subjects conducted by Roychansyah. The research has received ethical approval from the Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health and Nursing UGM with reference number KE/FK/1090/EC/2016. Data collection in the study was carried out in 2015 in the YUA area, which includes 23 sub-districts.

The population in this study are people who live in the YUA area, where it was measured to have higher compactness compared to outside YUA. Research subjects were selected based on inclusion criteria, namely male, and included in the category of young adults (18-39 years) and middle adults (40-59 years) (15). The exclusion criteria of this study were subjects with incomplete data on smoking habits, CRI, level of urban compactness, gender, and age. The number of issues that met the inclusion and exclusion criteria was 181.

The independent variable in this study is urban compactness level, while the dependent variables are smoking habits and CRI. The smoking habit is burning tobacco and smoking the smoke using cigarettes or pipes every day in the last month (16,17). The categories are divided into two based on a questionnaire filled with research subjects: smoking (meeting the definition of smoking habits) and non-smoking (not meeting the definition of smoking habits). The Cardiac Risk Index is calculated from LDL/HDL cholesterol levels. LDL and HDL cholesterol levels were measured from the subject's serum and expressed in mg/dL. This study classified CRI into three categories: <3.00 as low; 3.00 as 6.00 as moderate; and> 6.00 as high (18). The level of urban compactness in this study was assessed based on the Urban Compactness Index (UCI), provided that the value <62.54 is low; 62.54–71.04 is classified as moderate; and >71.04, which is classified as high (2). Analysis was performed using SPSS 23.0 with an independent t-test, one-way ANOVA, and chi-square test.

RESULTS

The characteristics of the subjects are presented in Table 1. The table shows that the subjects are dominated by middle-aged adults (40-59 years), 59%. Most of the subjects had a smoking habit, with 54.70%. Most subjects (55.80%) were in the medium CRI category, and none were in the high category. Most (52.49%) of the subjects live in areas with low urban compactness.

Table 1 Subject Characteristic

	Total	Mean ± SD	%
Age (years)		40,2 ± 7,1	
Young adult (18-39)	74		40,88
Middle adult (40-59)	107		59,12
Total	181		100,00
Smoking habits			
Smokers	99		54,70
Non-smokers	82		45,30
Total	181		100,00
LDL		125,9 ± 33,3	
HDL		42,19 ± 8,53	
CRI		3,06 ± 0,86	
- Low	80		44,2
- Moderate	101		55.8
- High	0		0
Urban compactness			
- Low	95		52.5
- Moderate	41		22.6
- High	45		24.9

Table 2. Subject's age characteristics based on smoking habits-1

Age	Smoking habits		Total	p-value
	Yes	No		
	n (%)	n (%)	n (%)	
Age (Mean±SD)	39,92±6,56	40,61±7,69		0,515[a]
18-39 years	44 (44,44)	30 (36,59)	74 (40,88)	
40-59 years	55 (55,56)	52 (63,41)	107 (59,12)	
Total	99 (100,00)	82 (100,00)	181 (100,00)	
CRI				
Low	35 (35,40)	45 (54,90)	80 (44,20)	0,008*[b]
Moderate	64 (64,60)	37 (45,10)	101 (55,80)	
Total	99 (100,00)	82 (100,00)	181 (100,00)	

[a]Independent t-test, *p<0,05; [b]Chi-square test

The percentage of middle adults (40-59 years) is dominant in subjects with smoking habits and those without smoking. The independent t-test results showed no significant difference in the mean age of subjects who had smoking habits and those who did not (p>0.05).

Table 2 shows effects of age and CRI on smoking habits. Most subjects who have a smoking habit have a moderate CRI category, while most subjects who do not have a smoking habit have a low CRI category. The chi-square test showed a significant relationship between smoking habits and CRI with a p-value of 0.008 (p<0.05).

Table 3 shows the age effect on CRI. The percentage of middle age (40-59 years) is dominant in both subjects with low and moderate CRI categories. The independent t-test showed no significant difference in the mean age of subjects with low and moderate CRI categories (p>0.05).

Table 3. Subject's age characteristic based on CRI

Age	CRI		Total
	Low	Moderate	
	n (%)	n (%)	n (%)
Age (Mean+SD)[a]	39,21±7,50	41,04±6,66	
18-39 years	37 (46,25)	37 (36,63)	74 (40,88)
40-59 years	43 (53,75)	64 (63,37)	107 (59,12)
Total	80 (100,00)	101 (100,00)	181 (100,00)

[a]Independent t-test, p-value 0,085

Table 4 shows factors on UCL. In every age characteristic, the percentage of subjects concentrate higher in the low urban compactness level, while middle age (40-59 years) is dominant at each level of urban compactness. However, this age category tends to increase in the low compactness level outside the city center. The one-way ANOVA results show no significant difference in the mean age of subjects between levels of urban compactness with a p-value of 0.299 (p>0.01).

Smoking habits effect. Most subjects living in areas with low and high urban compactness have smoking habits. In contrast, subjects living in areas with moderate urban compactness do not have a smoking habit. The chi-square test showed no significant relationship between the level of urban compactness and smoking habits, with a p-value of 0.075 (p>0.05).

CRI effect. The subjects living in areas with low and high urban compactness have a moderate CRI category. In contrast, subjects living in areas with moderate urban compactness have a low CRI category. The chi-square test showed no significant relationship between the level of urban compactness and CRI, with a p-value of 0.181 (p>0.05). The distribution of CRI data as a whole and based on the level of urban compactness is classified as normal.

DISCUSSIONS

It is interesting that the number of smokers in YUA is relatively high. The characteristics of this study indicate that 54.70% of subjects have a smoking habit. This result is in line with findings in Basic Health Research in 2010 (Riskesdas 2010), which showed that >54.10% of the male population in Indonesia aged >15 years are daily smokers (19). The prevalence of smokers in Indonesia is increasing from year to year. One of the reasons is that in Indonesia, smoking is seen as a tradition and even a part of the lifestyle. Therefore, it is not surprising that Indonesia is an up-and-coming cigarette market for the cigarette industry both at home and abroad (20). The difficulty in reducing the number of smokers in Indonesia is due to several reasons, namely: (1) the increasing number of cigarette advertisements, sponsorships, and promotions; (2) easy access to buy cigarettes; and (3) the low price of cigarettes with affordable taxes.

Indonesia is still unable to control cigarette advertising. Cigarette advertisements in Indonesia do

not feature smoking activities, but the concept promoted in these advertisements builds the perception that by smoking, a person can be more male, active, and have outstanding achievements. The main target is young people vulnerable to the temptation to smoke. Likewise, many youth activities, such as music concerts and sports competitions sponsored by the major tobacco industries. Besides, there is no regulation on the sale of cigarettes to and by minors in Indonesia, so almost everyone can buy and sell cigarettes (21).

Table 4. Subject's distribution based on urban compactness level, smoking habits and CRI-1

Age	Urban Compactness Level			Total	p-value
	Low	Moderate	High		
	n (%)	n (%)	n (%)	n (%)	
Age (Mean±SD)	40,38±7,15	41,29±6,65	38,96±7,29		0,299a
18-39 year	40 (42,11)	12 (29,27)	22 (48,89)	74 (40,88)	
40-59 year	55 (57,89)	29 (70,73)	23 (51,11)	107 (59,12)	
Smoking habits					
Smokers	49 (51,60)	19 (46,30)	31 (68,90)	99 (54,70)	0,075b
Non-smokers	46 (48,40)	22 (53,70)	14 (31,10)	82 (45,30)	
CRI					
Low	37 (38,90)	23 (56,10)	20 (44,40)	80 (44,20)	0,181b
Moderate	58 (61,10)	18 (43,90)	25 (55,60)	101 (55,80)	
Total	95 (100,00)	41 (100,00)	45 (100,00)	181 (100,00)	

[a]One-way ANOVA [b]Chi-square test

Indonesia is one of the countries that has not implemented business regulations and smoking behavior seriously. The excise duty on cigarettes in Indonesia is only about 31.50% of the selling price and is considered very low compared to other countries. Cigarette excise duty in Thailand reaches 79%, in Singapore, it comes to 85%, and in other ASEAN countries, it applies a figure of 75-85% (22). The low excise tax on cigarettes in Indonesia causes the low price so that even those classified as poor socially and economically can still afford them. This causes smoking to become the second priority after rice, even beating other nutritional needs, such as eggs, meat, fish, and milk. The impact is that the level of health worsens, and there is an increased death rate among the poor (23).

The inability to increase cigarette excise duty or tax in Indonesia is not accidental because cigarette customs can significantly contribute to state revenue. In 2006, Indonesia received IDR 38.5 trillion from cigarettes, which is predicted to be IDR 42 trillion in 2007 (20). This is why Indonesia does not immediately ratify international treaties, such as the Framework Convention on Tobacco Control (FCTC) (20,21).

Indonesia already has a regulation on controlling the problem of cigarettes, namely Government Regulation Number 19 2003. This Government Regulation regulates: (1) the nicotine and tar content of cigarettes; (2) requirements for cigarette production and sale; (3) requirements for cigarette advertising and promotion; and (4) determination of No Smoking Areas (NSA), namely rooms or areas that are declared prohibited from smoking or producing, selling, advertising, and promoting tobacco products. Regional Regulations and Governor Degrees govern the implementation of these regulations. However, both the Regional Regulations and the Governor's Decree experienced many obstacles in their execution, among others, due to unpreparedness of infrastructure, political barriers, and so on. The Special Region of Yogyakarta itself already has a regional regulation on smoking. Still, it has not been implemented because there are no implementing regulations at the city and district levels (24). Overall, no single region in Indonesia has implemented rules to effectively restrict smoking behavior (20).

The high condition of smokers in Indonesia is also supported by the entry of foreign cigarette manufacturers into Indonesia. Strict regulations abroad have caused foreign producers to seek marketing targets in countries where cigarette regulations are still loose, such as Indonesia (20). Seeing these various facts, it is not surprising that Indonesia's number of smokers is increasing yearly. Based on data from The ASEAN Tobacco Control Report in May 2015, more than 30% of Indonesian children start smoking under 10, reaching ± 20 million(22). The Basic Health Research in 2013 states that almost 80% of smokers in Indonesia started smoking at the age of fewer than 19 years (8).

For this reason, several efforts must be made to reduce the prevalence of smokers in Indonesia, including (1) increasing cigarette excise tax so that the majority of the population cannot reach the price of

cigarettes; (2) establishing strict regulations and implementations related to access to cigarettes; (3) increase the number of NSAs; (4) to give strict sanctions to every violator of the rules; (5) conduct intensive education, communication, training and public awareness about smoking; and (6) seeking alternative economic activities that can replace tobacco farming (21). In addition, the existing regulations regarding smoking behavior and tobacco products in schools must also be strictly enforced because most smokers start smoking at school. It is hoped that if all stakeholders and society are actively involved in implementing these regulations, it will reduce the prevalence of smokers in Indonesia.

In this study, age and gender variables were controlled. Comparison of the mean age of the subjects between groups of smoking habits, CRI, and urban compactness level was shown to be the same using an independent t-test and one-way ANOVA. All subjects of this study were male to control for the gender variable. Therefore, the analysis results of the relationship between smoking habits, CRI, and urban compactness level were no longer affected or not due to age and gender variables.

This study's results indicate no relationship between the level of urban compactness and the smoking habits of the people in the YUA area. The data of this study suggest that most subjects who live in areas with low and high levels of urban compactness have higher smoking habits. The high number of smokers in areas with high levels of urban compactness can be caused by the ease of getting cigarettes. This area has more trade places, such as minimarkets, than areas with moderate and low levels of urban compactness. Sites with high urban compactness also have a higher population density and activity, so the cigarette industry is targeting this area in terms of marketing its products, as seen from many cigarette advertising billboards along the main roads in the YUA area. The high number of smokers in areas with low levels of urban compactness can be caused by low socioeconomic status and fewer educational areas compared to areas with high and medium levels of urban compactness. The number of subjects (smokers) in the area of low urban compactness is also influenced by the lower density of the built environment pattern observed in the urban outskirts. Its condition may affect different microclimates that encourage the willingness to smoke.

On the other hand, the absence of a significant relationship between the level of urban compactness and smoking habits may be due to the many factors that can affect a person's smoking habits. Smoking in most young people because their parents or friends are smokers in Calcutta, India (25). These studies indicate that those smoker friends have 8.5 times the risk of becoming a smoker. On the other hand, someone with a smoker's sibling has a 4.5 times risk of becoming a smoker. The mean age of smokers in the study sample was older than the average age of non-smokers. This indicates that smoking occurs when older, especially in men (26). Besides, people who habitually chew tobacco and attend public schools also smoke (25).

Escobedo et al. and Mahesar et al. stated that the earlier a person starts smoking, the higher the risk of becoming a heavy smoker, greatly influenced by those around him (27,28). Owonaro and Eniojukan also reported that 75% of their study subjects started smoking from 16-25 years (29). Another factor that causes a person to smoke is that smoking is considered a way for young people to show their strength and role (27). Smoking also signifies that someone has become more mature (30). In addition, smoking is a way to socialize with other people or form social networks. By having a smoking habit, a person feels safer (27). Other studies found that smoking could reduce mental stress and other emotional problems (27,30,31).

Owonaro and Eniojukan add several reasons for a person to smoke. Smoking makes conditions more relaxed, improves appearance, makes it more resilient at work, and is not easily sleepy, as well as a friend when drinking alcohol (29). Lerman and Niaura (2002) reported that environmental and genetic factors contribute to smoking initiation (26). Jha et al. (2006) state that people more often smoke with lower socioeconomic conditions and attitudes that are harmful to health, such as drinking alcohol (32). The number of factors that influence a person's smoking habits apart from age and gender, which are controlled aspects in this study, is probably one of the reasons for the absence of a significant relationship between the urban compactness level and smoking habits.

This study also indicates no relationship between urban compactness and the Cardiac Risk Index of people in the YUA area. The data of this study suggest that subjects who live in areas with low and high levels of urban compactness have a moderate CRI category, which is higher than subjects who live in areas with average levels of urban compactness. One reason is the high number of smokers in areas with low and high levels of urban compactness. The smoking habit is a factor in a person's CRI.

Many factors influence smoking habits and uncontrolled CRI in this study and are not included in the urban compactness assessment indicator. Assessing of urban compactness include many aspects: (1) population densification including population density, the Basic Building Coefficient (BBC) for residential

areas, BBC for trade and services areas, BBC for office areas, and BCB for educational areas; (2) the concentration of activities includes the total area of workplaces/the total area of the sub-district, the area oftrade and services/the total area of the sub-district, as well as the area of residential area/the total area of the sub-district; (3) intensification of public transportation including the percentage of trips by public transportation/total trips, percentage of private vehicle ownership/1000 residents, various modes, percentage of trips using bicycles and walking/total trips, as well as the percentage of trips by private motorized vehicles/total trips; (4) city size and access includes the distance from the sub-district center to the farthest sub-district boundary, the distance from the sub-district center to the nearest shopping place, as well as the distance from the city center to the nearest social or public facilities; (5) population welfare includes the ratio of the unemployed/total working age population, the number of people aged >65 years/total population, the percentage of the number of prosperous families, and population per capita income (4).

However, the urban compactness index in YUA is still far from ideal. Aspects of densification and population welfare dominate the value of urban compactness in the YUA area. In contrast, the three other elements (concentration of activity, intensification of public transportation, and size and city access) still show a low value (2). The intensification aspect of public transport and the size and access of cities is closely related to physical activity, which influences CRI. This shows that the overall value of each aspect of urban compactness has not been evenly well distributed, so it has not made the community healthier.

The characteristics of the subjects of this study also indicate the inequality in the number of subjects between levels of urban compactness. The number of subjects living in areas with low urban compactness was two times the number of subjects in any other group of urban compactness. Besides, the variable category of smoking habits is still less detailed, such as not dividing by the number of cigarettes, smoking onset, or smoking duration. These reasons are probably the reasons for the absence of a relationship between the level of urban compactness and smoking habits and the CRI of the people in the YUA area. In addition, many factors influence smoking habits and uncontrolled CRI in this study, such as the influence of people around, the fulfillment of psychological needs, socioeconomic status, physical activity, diet, BMI, and genetics.

Based on the results of this study, the government needs to reduce the number of smokers and increase the value of every aspect of the urban compactness assessment evenly to achieve superior value and improve the health of its people. Research to bring together elements of the type and characteristics of the built environment and health performance should get more attention in Indonesia. An integrative approach such as the socio-ecological model (McLeroy et al., 1988) on how to relate macro aspects of the natural environment and implementation in individual determinants and its lifestyle, such as reducing smoking habits, should be applied more intensively on various scales (34). To get better research findings, further research needs to elaborate on multiple control factors that influence smoking habits and CRI that have not been controlled in this study, such as the influence of people around, fulfillment of psychological needs, socioeconomic status, physical activity, diet, BMI, and genetics; conduct an even distribution of the number of subjects between levels of urban compactness; and categorize smoking habit variables into more detail, such as dividing by cigarette consumption number, smoking onset, or smoking duration.

CONCLUSION

Smoking habits are significantly associated with CRI in people in the Yogyakarta Urban Agglomeration, an area of urbanized activities. Although there was no significant relationship between urban compactness level and smoking habits and CRI, this study highlighted that high smoking habits in regions with low levels of urban compactness in the city's outskirts should be given more attention and considered for future policy recommendations toward healthier communities. This study also reveals the importance of achieving a healthy community by considering integrated physical and activity milieus, from micro-individual to macro environment.

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