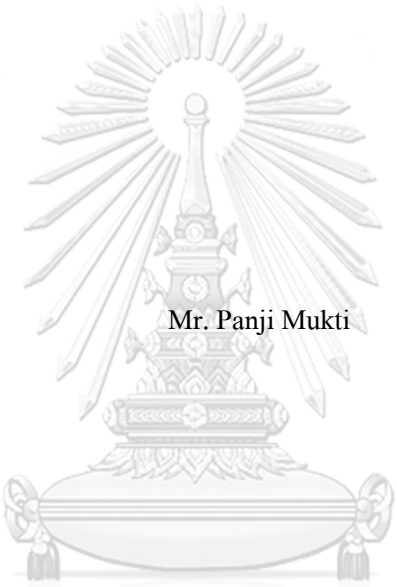
Health Risk Assessment Related to Cadmium and Lead Exposure from Cigarette Smoking among Indonesian Smokers in Surakarta, Indonesia: A Cross-Sectional Study

Mr. Panji Mukti



A Thesis Submitted in Partial Fulfillment of the Requirements

for the Degree of Master of Public Health in Public Health

Common Course

COLLEGE OF PUBLIC HEALTH SCIENCES

Chulalongkorn University

Academic Year 2021

"การประเมินความเสี่ยงด้านสุขภาพ ที่เกี่ยวข้องกับการรับสัมผัสแคดเมียมและตะกั่ว จากการสูบบุหรี่ ในกลุ่มผู้สูบบุหรี่ชาวอินโดนีเซีย ในสุราการ์ตา ประเทศอินโดนีเซีย: การศึกษาภาคตัดขวาง"

นายปันจิ มุคทิ

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรมหาบัณฑิต
สาขาวิชาสาธารณสุขศาสตร์ ไม่สังกัดภาควิชา/เทียบเท่า
วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2564

Thesis Title	Health Risk Assessment Related to Cadmium and Lead Exposure from Cigarette Smoking among Indonesian Smokers in Surakarta, Indonesia: A Cross-Sectional Study
By	Mr. Panji Mukti
Field of Study	Public Health
Thesis Advisor	POKKATE WONGSASULUK, Ph.D.

Accepted by the COLLEGE OF PUBLIC HEALTH SCIENCES, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Public Health

..... Dean of the COLLEGE OF PUBLIC HEALTH SCIENCES

(Professor SATHIRAKORN PONGPANICH, Ph.D.)

THESIS COMMITTEE

..... Chairman

(Associate Professor WATTASIT SIRIWONG, Ph.D.)

..... Thesis Advisor

(POKKATE WONGSASULUK, Ph.D.)

..... External Examiner

(Professor RATANA SOMRONGTHONG, Ph.D.)

ปันจิ มุคทิ : "การประเมินความเสี่ยงด้านสุขภาพ ที่เกี่ยวข้องกับการรับสัมผัสแคดเมียมและตะกั่ว จากการสูบบุหรี่ ในกลุ่มผู้สูบบุหรี่ชาวอินโดนีเซีย ในสุราการ์ตา ประเทศอินโดนีเซีย: การศึกษาภาคตัดขวาง". (Health Risk Assessment Related to Cadmium and Lead Exposure from Cigarette Smoking among Indonesian Smokers in Surakarta, Indonesia: A Cross-Sectional Study) อ.ที่ปรึกษาหลัก : ปกเกศ วงศาสุลักษณ์

อินโดนีเซียเป็นหนึ่งในประเทศกำลังพัฒนา ที่มีจำนวนผู้สูบบุหรี่มากที่สุด และอยู่ในอันดับที่สาม รองจากประเทศจีนและประเทศอินเดีย โลหะหนักเช่นแคดเมียมและตะกั่วที่ปนเปื้อนในควันบุหรี่นั้น และสามารถก่อให้เกิดอันตรายต่อสุขภาพได้ การศึกษานี้มีวัตถุประสงค์ คือ 1) เพื่อประเมินความเสี่ยงผลกระทบต่อสุขภาพ จากสารตะกั่วและแคดเมียม จากการสูบบุหรี่ ในชายชาวอินโดนีเซีย 2) เพื่อหาปัจจัยเกี่ยวข้อง ระหว่างข้อมูลประชากร ปัจจัยการรับสัมผัส และความเสี่ยงต่อสุขภาพ ของผู้สูบบุหรี่ชาวอินโดนีเซีย การศึกษานี้เป็นการศึกษาภาคตัดขวาง โดยใช้แบบสอบถามออนไลน์ เพื่อเก็บข้อมูลส่วนบุคคลและพฤติกรรมการสูบบุหรี่ ของชายชาวอินโดนีเซีย ที่อาศัยอยู่ในเมืองสุราการ์ตา ชายจำนวน 327 คนที่มีอายุระหว่าง 20-35 ปี ที่สูบบุหรี่มาแล้วเป็นเวลาอย่างน้อย 6 เดือน ได้เข้าร่วมตอบแบบสอบถามนี้ การประเมินความเสี่ยงผลกระทบต่อสุขภาพ จะวิเคราะห์และคำนวณ ตามหลักการ 4 ขั้นตอน ได้แก่ ขั้นตอนที่ 1 การกำหนดสารอันตราย ขั้นตอนที่ 2 การประเมินการตอบสนองต่อการรับสัมผัส ขั้นตอนที่ 3 การประเมินการรับสัมผัส และขั้นตอนที่ 4 การจำแนกลักษณะความเสี่ยง สำหรับการวิเคราะห์หาปัจจัยเกี่ยวข้องด้วยสถิตินั้น จะใช้ไคสแควร์ในซอฟต์แวร์ SPSS เวอร์ชัน 22 เพื่อค้นหาปัจจัยที่เกี่ยวข้องอย่างมีนัยสำคัญ ผลการศึกษา พบว่าผู้เข้าร่วมส่วนใหญ่ (13.5%) สูบบุหรี่ 7.85+5.47 มวนต่อวัน และสูบมาแล้ว โดยเฉลี่ย 3.18+2.56 ปี ผลการประเมินความเสี่ยงจากแคดเมียมและตะกั่ว พบว่าค่าเฉลี่ย Cancer Risk (CR) และ Hazard Quitient (HQ) ของแคดเมียม เท่ากับ $4.62x10^{-6}$ และ 128.2 ซึ่งอยู่ในช่วง $2.00x10^{-6}$ ถึง $5.48x10^{-6}$ และ 5.28–152.1 ตามลำดับ ส่วนค่าเฉลี่ย Cancer Risk และ Hazard Quitient ของตะกั่ว เท่ากับ 0.076 และ $1.83x10^{-11}$ ซึ่งอยู่ระหว่าง $7.55x10^{-11}$ ถึง $2.17x10^{-10}$ และ 0.003-0.905 ตามลำดับ ค่าเฉลี่ย Hazard Index (HI) เท่ากับ 128.3 และค่าเฉลี่ย Total Cancer Risk (TCR) เท่ากับ $4.62x10^{-6}$ จากผลการประเมินความเสี่ยง พบว่าผู้ตอบแบบสอบถามทั้งหมด (100%) มีความเสี่ยงต่อการเกิดโรคที่ไม่ใช่มะเร็ง ในขณะที่ 87.7% ของผู้ตอบแบบสอบถาม มีความเสี่ยงต่อการเกิดมะเร็ง นอกจากนี้ ผลการศึกษา ยังพบปัจจัยที่เกี่ยวข้องกับความเสี่ยงต่อสุขภาพ จากการแคดเมียมและตะกั่วในบุหรี่ อย่างมีนัยสำคัญทางสถิติ ได้แก่ น้ำหนัก จำนวนบุหรี่ที่สูบต่อวัน ความถี่และระยะเวลาในการสูบบุหรี่ การศึกษานี้สรุปได้ว่า แคดเมียมและตะกั่วที่ปนเปื้อนในบุหรี่ อาจก่อให้เกิดผลกระทบต่อสุขภาพที่ได้ ผลการศึกษานี้ ชี้ให้เห็นว่าผู้สูบบุหรี่ควรตระหนัก และคำนึงถึงความถี่ ปริมาณ และระยะเวลาในการสูบบุหรี่ ที่อาจทำให้ผู้สูบบุหรี่

สาขาวิชา	สาธารณสุขศาสตร์	ลายมือชื่อนิสิต .....
ปีการศึกษา	2564	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

6474017053 : MAJOR PUBLIC HEALTH

KEYWORD: Cadmium Lead Smoking Heavy Metals Health Risk Assessment Cancer risk.

Panji Mukti : Health Risk Assessment Related to Cadmium and Lead Exposure from Cigarette Smoking among Indonesian Smokers in Surakarta, Indonesia: A Cross-Sectional Study. Advisor: POKKATE WONGSASULUK, Ph.D.

Indonesia is one of the developing countries that have the highest number of smokers and ranks third under China and India. Heavy metal such as cadmium and lead poses major health hazards which are found in tobacco smoke. This study aimed 1) to assess the cancer risk and non-cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers 2) to find the association between socio-demographic, exposure factors, and health risk among Indonesian smokers. This study was a cross-sectional study using an online questionnaire to get the personal information and smoking behavior among Indonesian male smokers who lived in Surakarta city. The survey was conducted on 327 subjects aged 20-35 years old who continue to smoke for at least 6 months. The data analysis was using 4 steps of Health Risk Assessments for inhalation from the US EPA which were; step 1 Hazard identification, step 2 Dose-response assessment, step 3 Exposure Assessment, and step 4 Risk Characterization. For statictical analysis, chi-square was performed using SPSS software version 22 to find the associated factors. The results showed that most of the participants (13.5%) were smoking 7.85 + 5.47 cigarettes per day with an average of 3.18 + 2.56 years. Both cancer risk and non-cancer risk of cadmium (Cd) and lead (Pb) exposure through inhalation were assessed and found the average cancer risk (CR) and non-cancer risk (HQ) of Cd were $4.62x10^{-6}$ and 128.2 which ranged from 2.00×10^{-6} to 5.48×10^{-6} and 5.28 – 152.1, respectively. The results found the average cancer risk (CR) and non-cancer risk (HQ) of Pb were 0.076 and 1.83×10^{-11} which ranged from 7.55×10^{-11} to 2.17×10^{-10} and 0.003-0.905, respectively. The mean Hazard Index (HI) result showed 128.3 and the mean Total Cancer Risk (TCR) shown 4.62×10^{-6}. According to the risk assessment results, all of the respondents (100%) found non-cancer risk, while 87.7 % found cancer risk. While there were associations between weight, cigarette number, smoking times, and smoking duration in minutes to the cancer risk and non-cancer risk of cadmium and lead. This study concluded that cadmium and lead contained in cigarettes may pose adverse health risks to smokers for both cancer risks and non-cancer risks. These findings suggest that smokers should give more concerned on the frequency and duration of smoking, related to the heavy metals contamination in cigarettes that may cause non-cancer and cancer risk for long term smoking.

Field of Study:	Public Health	Student's Signature .....
Academic Year:	2021	Advisor's Signature .....

ACKNOWLEDGEMENTS

I deeply express my gratitude and appreciation to my thesis advisor Dr. Pokkate Wongsasuluk and the Chairman of final thesis exam Assoc. Prof. Dr. Wattasit Siriwong for their support, their patience for always hear my barriers, their kindness and guidance throughout the whole process of this MPH study. I would like to say a great thank to Prof. Ratana Somrongthong, Ph.D. an external examiner of my thesis examination board for their continuous support and useful comments. I would like to express my sincere thanks to all my teachers at Master of Public Health program in College of Public Health Science who have given support and guidance throughout my study. I also would like to thank to:

1. Graduate School of Chulalongkorn University that supported me as an AEC Scholarship student.

2. Prof. Sathirakorn Pongpanich, Ph.D., the dean of College of Public Health Science.

3. Mr. Poohmerat for always guide us as Indonesian student in every aspects since I applied to the College of Public Health Science.

4. And, to all my family in Indonesia that always fully supported me & Indonesian student family who are always support each other.

Special thanks are given to the my god, Allah SWT for blessing in the entire process of my MPH study. I also

would like to express my recognition to all of my friends for their kindness and sincerely support throughout my

Master's degree.

Panji Mukti

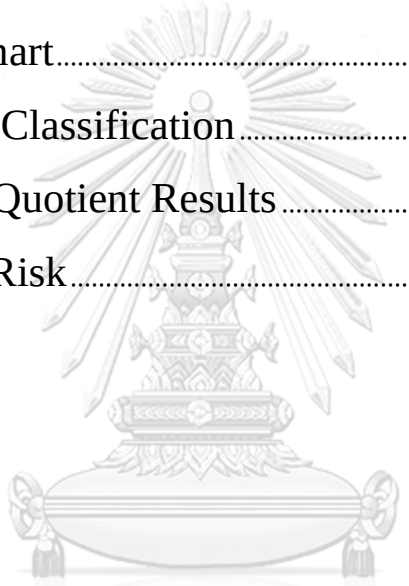
TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page



CHAPTER I
INTRODUCTION

1.1 BACKGROUND & RATIONALE

Tobacco is a public health threat that kills more than 8 million people worldwide. Tobacco makes active smokers to die more than 7 million and people with passive smokers around 1.2 million of the total death rate. Tobacco users who lived in low-middle-income countries accounted for 80% which causes very high health problems related to illness and death. In addition, tobacco also affects a country's economic growth due to the costs that must be borne as a result of emerging diseases. Data from the 2015 Global Burden of Disease Study shows a prevalence rate of 25% in men, half of which live in 3 Asian countries—China, India, and Indonesia. Based on (Yang JJ 2019) Yang et al. (2019) found that the current smoking trend has increased in men, both cigarettes smoked per day and the death rate from lung cancer or others shows a higher number in the younger generation than the older generation. Indonesia in 2010 only contributed 1.9% of world production. Indonesia is one of the largest tobacco-producing countries in the world, which ranks seventh at 144,700 tons per year. In the last 30 years, tobacco consumption in Indonesia has increased from 33 billion cigarettes per year in 1970 to 217 billion cigarettes in 2000. From the WHO Southeast Asia Regional Tobacco Free Initiative (TFI) data, information is obtained that smokers accounted for 63.2% of male smokers, whereas, female adult smokers as 4.5% (over 15 years). The results of the 2010 basic health research conducted by the Ministry of Health show that the prevalence of smoking in Indonesia currently reaches 34.7%.

1.1.1 Tobacco plants

Tobacco refers to several plants especially the leaves that contain a certain amount of addictive chemical nicotine. The process from harvesting, tobacco leaves are cured, aged, and processed in various ways. Worldwide data recorded that tobacco is the cause of various health problems as well as

the main factor of eight causes of mortality and morbidity worldwide that can be done in prevention efforts. 1 in 10 women and 1 in 5 men in the age range 13-15 use tobacco worldwide. Data from the World Health Organization shows that four million people die every year due to tobacco consumption and it is estimated that this number will continue to increase in the next few years, while for children and young people it is 250 million, especially in developing countries (WHO, 2008). From the increasing number of studies conducted on the effects of tobacco on health, it is suggested to stop smoking to get a longer life span.

Tobacco use at a young age has a close relationship in determining health in the long term due to the effects of dependence which are always associated with the incidence of heart disease, cancer, and premature death (WHO, 2011). Some of the motivations of adolescents in tobacco use have been identified such as high curiosity, a sense of being recognized in a community, and the influence of families who use tobacco. In addition, the low level of education of the adverse effects of smoking is a contributing factor as well (Peltzer, 2003; Kwamanga, 2003).

1.1.2 Smoking in Indonesia

Indonesia is one of the developing countries that have the highest number of smokers and the highest level of cigarette consumption in the world which makes Indonesia ranks third which have the most number of smokers under China and India. Based on data from the population census of adolescents in Indonesia in 2010 showed 26.7% tried tobacco for the first time at the age of 18 years. The data implies concern because there is an increase in the number of active smokers and the first smoking trial is getting earlier, especially since Indonesia is a developing country. Data from National Health Research / Riskesdas (2018), the proportion of tobacco users has doubled and is dominated by men (Warren, 2000). Factors that influence the increase in the amount of tobacco consumption in Indonesia include population growth, relatively cheap cigarette prices, aggressive marketing of the cigarette industry, and low cigarette tax (WHO, 2019).

These increasing numbers suggest that health officers or governance should improve the implementation of antismoking and develop new strategies in order to tackle the issue and continued declines in youth smoking.

1.1.3 Heavy metals

Heavy metals such as lead and cadmium pose major health hazards. Lead and cadmium are both toxic, as indicated by their inclusion in the Agency for Toxic Substances and Disease Registry's top ten environmental dangers list. While the amount of metals in a single cigarette is modest and unlikely to be acutely hazardous, the buildup of metals in the body over months, years, and decades of exposure is a health risk, depending on clearance rates. After smoking, some heavy metals contained in tobacco smoke, such as Cd, Cr, Pb, and Ni, accumulate in tissues and fluids. This is especially problematic for cadmium (Cd) and lead (Pb), both of which have extended (10–12 year) half-lives in the human body. In the general population, cigarette smoking is a significant source of exposure to Cd (and to a lesser extent, Pb) (Blecher, 2018). Cadmium and lead, both of which are found in tobacco smoke, contribute significantly to the risk of cancer (Galazyn et al., 2008). Cadmium is classified as a group I carcinogen, while lead was recently elevated from group IIB to group IIA (Fowles, 2003).

1.1.4 Health Risk Related to Heavy Metals Exposure

Heavy metals have a variety of adverse health effects, some of which are induced by cadmium. Acute inhalation exposure to cadmium at levels greater than roughly 5 mg m-3 may cause lung epithelial cell death, resulting in pulmonary edema, tracheobronchitis, and pneumonitis. Inhalation exposure at low levels over time also results in impaired lung function and emphysema. Another result of chronic cadmium inhalation exposure is the impairment of olfactory function. Exposure to cadmium in the environment is unlikely to be high enough to induce substantial respiratory effects (Leduc et al., 1993).

Due to direct irritation of the gastric epithelium, the gastrointestinal tract is the target organ for high-level, acute oral exposure to cadmium in

humans and animals. In humans, the primary symptoms associated with cadmium intake at dosages more than around 0.07 mg kg-1 are nausea, vomiting, and stomach pain. Gastrointestinal toxicity has not been detected following oral or inhalation exposure to cadmium, indicating that gastrointestinal effects are unlikely to arise as a result of environmental cadmium exposures. Shipmaster (1986). While both lead and arsenic can impair cognitive function in children and adults, children are more vulnerable. While inhalation and oral exposure are the primary routes of exposure for adults and children alike, children are more likely to come into touch with contaminated surfaces as a result of ground play and hand-to-mouth interactions. Perhaps more importantly, the growing neurological system is particularly vulnerable to lead intoxication. Lead impairs synaptic pruning and trimming during brain development, as well as neuron migration and neuron/glia connections. The time interval between exposure and reaction appears to have played a role in the inability to develop a "behavioral hallmark" of lead exposure (Davis & Svendsgaard, 1987).

1.1.5 Smoking Adverse Health effects

Smoking is a habit that has a negative impact on the health of the world community, not least in Indonesia. The average active smoker in Indonesia is aged 30-34 years, with the highest number of smokers by sex being male, namely 47.5% and female 1.1%. The death rate that occurs due to smoking habits reaches 240,618 deaths per year. In ASEAN, the highest prevalence of adult male smokers is in Indonesia, namely 66% and the highest adult female smokers are in Indonesia, Laos, Myanmar, and the Philippines, which are between 5.8%-8.4%. The main causes of death from tobacco in Indonesia are heart disease, stroke, cancer, and respiratory disease, especially chronic obstructive pulmonary disease. Estimates show that tobacco use in Indonesia is the leading cause of death among smokers, responsible for around 225,700 premature deaths annually (nearly 15% of all deaths). Studies reviewed by the World Bank in 2018 have found household

smoking is associated with decreased growth and weight in children, contributing to the stunting epidemic in Indonesia (World Bank, 2018).

Because smoking habits are often found in Indonesian society and have an important role in triggering deaths due to heart disease in Indonesian society, researchers have an interest in conducting further research on the Health Risk Assessment Related to Cadmium and Lead Exposure from Cigarette Smoking among Indonesian Smokers in Surakarta.

1.2 RESEARCH QUESTION

Based on the description in the background above, the researcher's questions can be formulated as follows:

1.2.1 Is there any cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers?

1.2.2 Is there any non-cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers?

1.2.3 Is there any association between socio-demographic, exposure factors, and health risk among Indonesian smokers?

1.3 RESEARCH OBJECTIVES

1.3.1 General objective

To assess the human health risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers.

1.3.2 Sub-objectives

- To investigate the cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers.
- To investigate the non-cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers.
- To find the association between socio-demographic, exposure factors, and health risk among Indonesian smokers.

1.4 RESEARCH HYPOTHESIS

1.4.1 There are cancer risks related to heavy metals exposure from cigarette smoking among Indonesian smokers.

1.4.2 There are non-cancer risks related to heavy metals exposure from cigarette smoking among Indonesian smokers.

1.4.3 There are associations between socio-demographic, exposure factors, and health risk among Indonesian smokers.

1.5 SCOPE OF STUDY

1.5.1 Study area

This research was conducted in the city of Surakarta located in the south of Indonesia in Central Java. The total population of 562,269 people obtained a population density of 12,767 people per km^2 with the rate of smoking 19.16% (Riskesdas, 2018). This city is also the third-largest city in the southern part of Java Island

1.5.2 Subjects

The subjects of this study was male smokers who resided in Surakarta city, Indonesia.

1.5.3 Sample collection:

The online questionnaire is used for collecting the data via Google form.

1.5.4 Data analysis

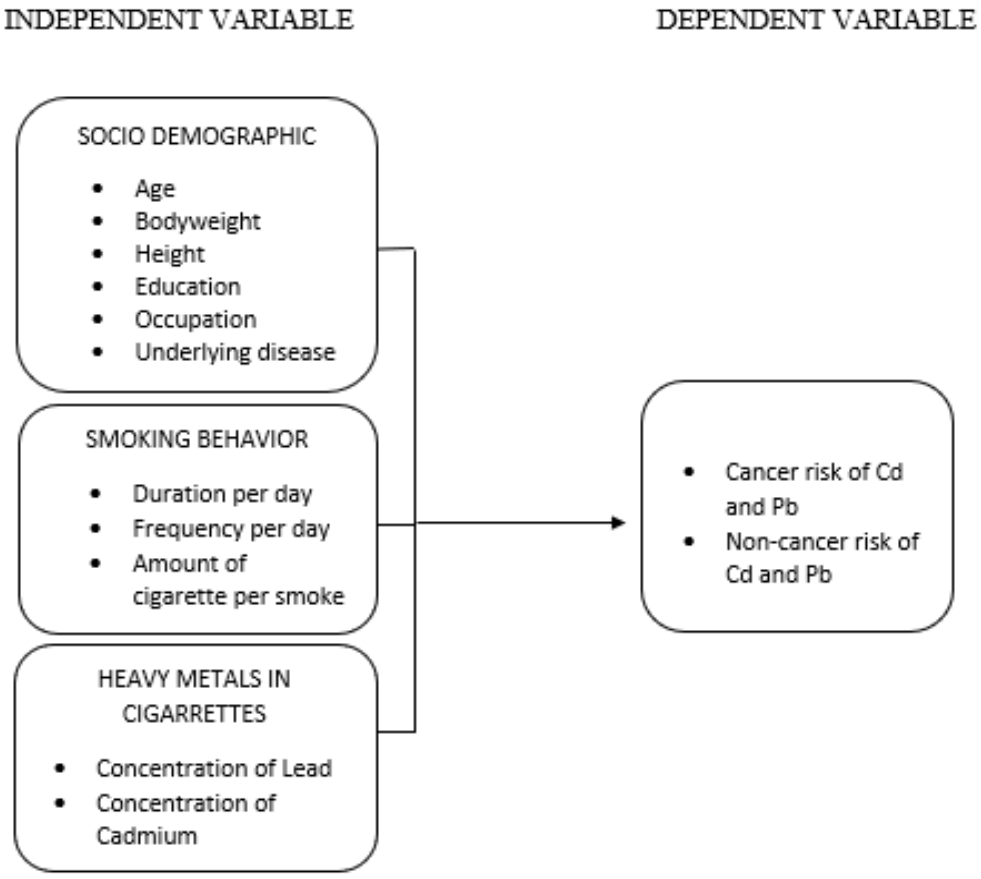
Descriptive analysis used to calculate continuous variables (mean, standard deviation, frequencies, percentages). Chi-square used to find the associated factors of cancer and non-cancer risk. Four steps of health risk assessment also used to estimate the nature and probability of adverse health effects in humans who are exposed to lead and cadmium from cigarettes.

1.5.5 Research Ethic:

This research was approved by the Research Ethics of Institutional Review Board, an independent institution within Faculty of Medicine, University of Muhammadiyah Jakarta, Indonesia No. 070/PE/KE/FKK-UMJ/IV/2022.

1.6 CONCEPTUAL FRAMEWORK

Figure 1 Conceptual Framework



1.7 OPERATIONAL DEFINITION

Table 1 Operational definition

Conceptual variable	Operational Definitions
Smoker	In this study refer to a male smoker of Indonesian people who smoke cigarette made in Indonesia for at least 6 months, who resided in Surakarta. The duration of 6 months was chosen to emphasize that respondents are still exposed to

	heavy metals.
Cancer Risk	The cancer risk of lead and cadmium consumption from cigarettes such as lung cancer. To identify cancer risk use the calculations contained in step 4 of the health risk assessment (LADD x SF (Slope Factors)). U.S EPA (1994)
Non-cancer risk	The non-cancer risk of lead and cadmium consumption from cigarettes such as diabetes, cardiac illness: coronary heart disease. To identify non-cancer risk use the calculations contained in step 4 of the health risk assessment (C^{air} / RfC (Reference Concentration)). U.S EPA (1994)
Heavy metals exposure	Heavy metals in this study focus on cadmium (Cd) and lead (Pb) as the components of cigarettes which have a concentration of 0.93 µg/g and 14.51 µg/g per cigarette. These amounts are the highest heavy metals concentration found in Indonesia (Dinh, et al., 2021).
Tobacco	Tobacco is produced from the plant's Nicotiana Tabacum, Nicotiana Ristica, and other types of others containing nicotine and tar with or without additives.
Cigarette	Cigarettes whose packaging material is in the form of paper containing chopped dried tobacco leaves produced by local factory in Indonesia. To ensure that the cigarettes were produced in Indonesia, the researchers examined several packages which contained the name of the factory with an address in Indonesia and also searched the profile of the manufacturer from the internet.
Health Risk Assessment	Has the aim of testing the health risks that arise as a result of the content of Lead and Cadmium in smokers aged 20-35 years in the city of Surakarta by calculating using the formula contained in the 4-step assessment.
Underlying Disease	A presence disease for more severe complications that suffer by the participants such as hypertension, diabetes, cardiovascular.
Education	This study, start from elementary, primary, secondary school, and bachelor's degree of the participant's education.
Occupation	Respondent's occupation at the time of interview.
Height	Respondent's height at the time of interview.

Bodyweight	Respondent's body weight at the time of interview.
Gender	The male participant is the target of the research.
Age	Respondent's age at the time of the interview, age range 20-35 years old

1.8 EXPECTED OUTCOME

1.8.1 The cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers.

1.8.2 The non-cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers.

1.8.3 The association between socio-demographic, exposure factors, and health risk among Indonesian smokers.

CHAPTER II
LITERATURE REVIEW

This chapter contains five sub-chapters. The first part of the library contains previous research or scientific literature and important information such as concentrations of some heavy metals. Some of the concepts discussed include the definition of tobacco, smoking conditions in Indonesia, heavy metal content in cigarettes, health effects of smoking, health risk related to heavy metals. These concepts are presented as concepts used so that there are no differences in understanding. From the literature search, the researchers found some scientific literature that talks about the heavy metal content found in Indonesian cigarettes. However, it turns out that there are still very few scientific papers that examine the content of heavy metals in Indonesia. In contrast to the literature on the definition of smoking and the state of smoking in Indonesia, which quite a lot of researchers found.

2.1 TOBACCO DEFINITION

The WHO Framework Convention on Tobacco Products (WHO FCTC) defines a tobacco product as “a product that is wholly or partly made from tobacco leaves as a raw material manufactured for use for smoking, sucking, chewing or inhaling”. Tobacco is a unique product in the sense that it is the only legal consumer product that kills up to half of its regular users when used as recommended by the manufacturer. Tobacco produced from the plant’s Nicotiana Tabacum, Nicotiana Ristica, and other types of others containing nicotine and tar with or without additives, more than 70 species of tobacco are known, but the main commercial crop is N. tabacum. Stronger variants of N. Rustica are also used in some countries (WHO, 2018). Meanwhile, cigarette smoke is produced by burning cigarettes. Cigarette smoke consists of the main smoke and side smoke. The main smoke is the smoke that is inhaled into the lungs of smokers, while side smoke is cigarette smoke that comes from the burning end of the cigarette. Main smoke contains 25% harmful substances and side smoke contains 75% harmful substances. So that passive smoker’s

smoke inhales 3 times more harmful substances than active smokers (Indonesian Minister of Health. 2013).

Tobacco is one of the major health problems that can kill 8 million people worldwide with a percentage of 7 million active smokers and 1.2 million passive smokers (Global Burden Disease, 2019). Overall the ingredients in tobacco are as dangerous as those in cigarettes. The impact that often arises from smoking is cancer such as cancer of the mouth, neck, throat, and so on. More than 80% of cigarette users come from developing countries with a high burden on the state for diseases caused by smoking. Tobacco often ropes the needs of the basic demands such as food and shelter which makes the burden increase, especially in the poverty aspects. The economic costs of tobacco use are enormous and include the significant health care costs of treating diseases caused by tobacco use as well as the loss of human capital resulting from tobacco-induced morbidity and mortality.

2.2 SMOKING IN INDONESIA

According to the Big Indonesian Dictionary is an activity of smoking cigarette. Cigarettes are tobacco rolls about the size of a pinkie wrapped in palm leaves or paper. Smoking has been done since ancient China and Rome, by smoking potions that emit smoke and create pleasure by being sucked in through the nose and mouth. A definition was put forward by Armstrong who described smoking as an activity of sucking in tobacco smoke and exhaling it back out (Danusanto, 1991).

A smoker is someone who inhales cigarette smoke either directly through cigarettes or not. The active smoker is someone who smokes cigarettes regularly, although only one stick, or people who smoke cigarettes though not routine or just try and suck cigarettes by exhaling smoke and not entering the lungs. While passive smokers are people who are non-smokers but participate in inhaling other people's cigarette smoke or people who are in a closed room with people who smoke (Ministry of Health RI, 2012). In tobacco use, there is a significant effect, especially on the development of chronic diseases that cause morbidity and premature death. the number of diseases that arise such as

heart disease, stroke, cancer, and lung disease. as many as 225,700 people experience premature death each year (WHO, 2018). According to The Tobacco Atlas (2018), most who become passive smokers are women who have family members who smoke passively which results in premature death as much as 7% of deaths are associated with tobacco.

The number of adult smokers prevalence continues to increase, there are 60.8 million male adult smokers and 3.7 million female adult smokers and it is estimated that this will continue to increase over time. This number makes Indonesia one of the countries that have a high amount of tobacco consumption (Global Data, 2019). The data from Riskesdas 2018 shows, 19,16 % of daily smokers in Surakarta city with the group age 20-24, 25-29, 30-34 are 26.77%, 29.55%, 30.17% in Central Java respectively. Tobacco use among teenagers aged 10-19 years also showed a significant increase, although not as much as that recorded in the number of adult smokers, which increased from 7.2% in 2013 to 9.1% in 2018. The prevalence is based on the age group 20-35 years old because it is quite a high number. The 35 years old older is not included as it is using an online questionnaire (Riskesdas, 2018). The duration of 6 months was chosen to emphasize that respondents are still exposed to heavy metals, according to Australian Smoking Cessation Guidelines if smokers don't smoke for 6 months, body condition, especially lungs, will get better without exposure to cigarettes (Zwar et al., 2012).

The Global Burden Disease issued a statement that tobacco carries a risk of premature death and morbidity in Indonesia, one of which is cardiac vascular diseases which estimated 558 736 deaths each year (36.3% of all deaths) (Mboi et al., 2016). The significant number of people with cancer and CVD can be attributed to the adverse effects of smoking. This increased burden of Non-Communicable Diseases due to tobacco use is one of the major stress factors on the national health system, thereby threatening the progress of Indonesia toward Universal Health Coverage.

In addition, tobacco is also an obstacle for Indonesia because smokers are more susceptible to illness, the more people who are sick, the more state

expenditures related to NCDs treatment will become excess demand which represents 6% of total health care spending or around IDR 15 trillion (Goodchild et al., 2016). The government provides subsidies to the poor under the national health insurance program or commonly known as the Jaminan Kesehatan Nasional or JKN. The high use of tobacco among the poor increases their vulnerability to developing chronic diseases, posing catastrophic JKN costs which often drain additional state budgets.

2.3 HEAVY METALS IN TOBACCO

Tobacco has a lot of toxic content and is very dangerous for the human body, one of which is heavy metals such as lead and cadmium which can enter the human body through the air (Galazyn et al., 2008). Several heavy metals in cigarettes were recorded, such as cadmium (Cd), chromium (Cr), lead (Pb), arsenic (As), and nickel (Ni) which also accumulate in human cells. Tobacco is an important contributor to cadmium exposure apart from food sources. Cigarette smoke stores amounts of cadmium in the range of 1000 to 3000 g/kg (Viana, 2011). One pack of cigarettes contains 2-4 g/kg to the lungs of smokers while the rest will then be inhaled by those around them or commonly referred to as passive smokers, both of which have a risk of exposure to cadmium which is dangerous and has an impact on health.

Cadmium is the metal that has been examined the most in relation to cigarette smoke. Cigarette smoking is the primary way in which humans consume cadmium. Numerous research has been conducted to determine the cadmium content in cigarettes and cigarette smoke. Although the amount of Cd in cigarettes varies, the average Cd concentration per stick is between 0.5 and 1.5 mg. While the disparate results could be explained by the use of different analysis techniques, they were most likely caused by the difference in cigarette brands. When a cigarette is smoked, the cadmium in the cigarette is transformed to cadmium oxide, which is breathed. Around 10% of Cd is retained in the lungs, while the remaining 20%–50% is transported to the circulation. Satarug and Moore (2004) showed that smokers' mean whole blood Cd content was 1.9 times that of nonsmokers (2.67+1.21 mg/l and

1.37+0.45 mg/l, respectively (mean+SD, mean age 30 years). Satarug et al. (2004) found that smokers had a 1.7-fold higher serum Cd level than nonsmokers (0.92+0.83 mg/l and 0.55+0.48 mg/l, mean age 36 years).

Cadmium accumulates not only in the bloodstream but also in the kidneys, particularly in the cortex, where metallothioneins chelate and immobilize Cd. Numerous studies have demonstrated that this buildup of cadmium in the kidneys results in tubular malfunction and renal end-stage failure, but there is also evidence that the amount of cadmium given by smoking is insufficient to cause kidney failure. Additionally, it has been demonstrated that Cd depletes bone mineral density (osteoporosis) and causes osteomalacia. Additionally, it has been demonstrated that Cd from cigarette smoke reduces birth weight, and while the placenta appears to protect the fetus from maternal Cd, the child's Cd load increases shortly after birth via breast milk (Kuhnert et al., 1987). Finally, it is suspected that Cd may contribute to the development of cataracts, emphysema, hypertension, and cardiovascular disease (Hendrick, 2004). Although the primary source of lead is not smoking, the contribution of continued smoking and the increasing amount of lead are inextricably linked. A cigarette contains approximately 1.2 milligrams of lead, and approximately 6% of that amount goes through the primary smoke inhaled by smokers. Mortada et al. (2004) recorded blood lead levels of 101.6 + 30.9 mg/l in non-smokers and 143.7 + 33.8 mg/l in smokers, while Satarug & Moore (2004) observed serum lead levels of 4.2 + 5.4 mg/l in non-smokers and 9.0 +12 mg/l in smokers. The substantial discrepancy in Pb concentrations between blood and serum is attributable to the fact that most circulating Pb is linked to erythrocytes (Jarup, 2003).

Pb is excreted from the body via the urine, but this process is sluggish, resulting in a buildup in the bones. Although Pb is generally impervious to the blood-brain barrier, children, in particular, are at significant risk of accumulating neurotoxic Pb in the brain and central nervous system, resulting in mental retardation and other neurological diseases (Preuss, 1993). Additionally, children of smokers accrue elevated blood lead levels through

passive smoking. These data are simply one more illustration of the critical need to safeguard youngsters from both active and passive smoking. Additionally, lead accumulation may result in hypertension, peripheral arterial disease, and cataract (Navas et al., 2004).

Cigarette smoke contains a high concentration of heavy metals, which are typically absorbed into the body by inhalation. Because poisonous compounds are quickly absorbed through the respiratory tract, inhalation is the simplest and quickest method of exposure to harmful substances. The lining of the respiratory tract is ineffective at preventing hazardous compounds from being absorbed into the body. The larynx (voice box), trachea (windpipe), nasal passages, and lungs comprise the respiratory tract. The concentration of a poisonous substance in the air, the solubility of the substance in blood and tissue, the rate of respiration, the duration of exposure, the state of the respiratory tract, and the size of the toxic particle all have an effect on inhalation of harmful compounds.

Table 2 Heavy Metals Concentration in Cigarette

Country (Ref.)	Lead (µg/g)	Cadmium (µg/g)	Hg (ng/g)
China (Yang et. al., 2005)	0.64 (ave.)	0.18	-
Indonesia (Dinh, et al., 2021)	1.58 (ave.) 0,13-14.51 (Min-Max)	0.70 (ave) 0.48-0.93 (Min-Max)	14.19 (ave) 10.32-18.97 (Min-Max)
Malaysia (Janaydeh et al., 2019)	0.08	3.05	-
Saudia Arabia (Ashraf. 2012)	1.81	2.46	-
Thailand (Dinh, et al., 2021)	0.98 (ave.) 0.67-1.32 (Min-Max)	2.48 (ave.) 1.85-3.89 (Min-Max)	27.80 (ave.) 26.38-28.92 (Min-Max)
Japan (Dinh, et al., 2021)	0.43 (ave.) 0,13-0.66 (Min-Max)	0.67 (ave.) 0.45-0.90 (Min-Max)	18.38 (ave.) 15.47-22.87 (Min-Max)
Italy (Dinh, et al., 2021)	0.48 (ave.) 0.40-0.59 (Min-Max)	0.65(ave.) 0.47-0.74 (Min-Max)	12.37 (ave.) 11.57-13.18 (Min-Max)

Std. of HMs (WHO)	2 mg/kg 0,002 µg/g	0.02 mg/kg 2e-5 µg/g	-

2.4 SMOKING ADVERSE HEALTH EFFECTS

Smoking contributes to health concerns owing to the presence of heavy metals. Lead Pb exposure is tightly related to its accumulation in networks, causing beneficial physiological processes directly or indirectly at the molecular level. Lead has persistent consequences because Pb that enters the body via the respiratory or digestive route inhibits heme production. As a result, Pb may inhibit the creation of blood Hb, resulting in the emergence of further health concerns. Small amounts of Cd ingested over an extended period of time may cause renal damage and weak bones, as Cd is mostly stored in bone, the liver, and the kidneys. Additionally, Cd irritates the stomach, produces vomiting, and diarrhea. Cadmium and lead, both of which are found in tobacco smoke, contribute significantly to the risk of cancer (Galazyn, 2008). Cadmium is classified as a group I carcinogen, while lead was recently elevated from group IIB to group IIA (Fowles, 2003).

2.4.1 Cancer Risk of Smoking

Cancer is a disease that arises as a result of growth abnormally body tissue cells that turn into cancer cells (Indonesian Ministry of Health, 2015). Meanwhile, according to WHO, cancer is a disease characterized by abnormal cell growth beyond normal limits that can then invade adjoining body parts and/or spread to other organs. Other terms used for cancer are malignant tumors and neoplasms.

Cancer is a non-communicable disease, or NCD (Non-communicable disease), and the leading cause of mortality globally. Until now, cancer has been one of the world's major health challenges, especially in Indonesia. Cancer is one of the top causes of morbidity and mortality worldwide, according to WHO estimates from 2013, with around 14 million new cases in 2012. Over the next two decades, the number of new cases is predicted to climb by around 70%. Cancer is the world's second-biggest cause of death, accounting for 8.8 million

deaths in 2015. Cancer is responsible for almost 1 in every 6 deaths worldwide. Around 70% of cancer fatalities occur in low- and middle-income nations. Men are more likely to develop lung, prostate, colorectal, stomach, and liver cancers, whereas women are more likely to develop breast, colorectal, lung, cervical, and stomach cancers. Cancer occurs with a rate of 0.14 percent in Indonesia for all ages (Basic Health Research Data, 2013)

a. Etiology

Supriyanto (2014), said that cancer is caused by many factors, and develops over the years. The following is the most common factors that cause cancer are:

1. Virus
   (a) Human Papilloma Virus (HPV), the virus suspected to be the cause of cervical cancer.
   (b) Hepatitis B and C viruses, both of which are suspected to be the cause of heart cancer.
   (c) Epstein-Bar virus, a cause of nose and throat cancer
   (d) The HIV virus (Human Immunodeficiency Virus), is the cause of lymphoma and other blood cancers.

2. Bacteria
   (a) Schistosoma or Biliharzia parasites can cause cancer bladder.
   (b) Clonorchis Sinensis infection, is a cause of pancreatic disease and bile duct.
   (c) Helicobacter pylori, is the cause of gastric cancer.

3. Chemicals (carcinogens)

   Carcinogenic substances include cigarette smoke, asbestos, and alcohol. In addition, the chemicals found in foods that are over-processed, such as deep-fried foods oil is reused, smoked, or burned. Can also contain food preservatives and dyes, and

eating contaminated with harmful metals, like mercury in seafood.

4. Ultraviolet (UV) Light Exposure

   Excessive exposure to ultraviolet (UV) radiation from the sun especially between 10:00 to 14:00 can cause sunburn. Permanent damage to skin and eyes in the long term has the potential to cause skin cancer.

5. Tension or Stress

   Chronic stress can weaken a person's immune system ultimately can be one of the triggering factors for cancer, such as Kaposi's sarcoma and certain types of lymphoma (lymph cancer). Stress also has a negative effect on the release of endocrine hormones, namely a hormone that regulates DNA repair that regulates cell growth.

6. Hormone

   Hormone therapy has been used for many years by women in menopause to relieve symptoms and inhibit the symptoms of osteoporosis. However, this is not without side effects. Because there is a relationship between hormone therapy users (a combination of progesterone and estrogen or estrogen). By increasing the risk of developing breast cancer and cancer ovaries in women.

7. Genetic Factor

   About 5-10% of cancer cases are inherited. In certain families, abnormal genes can be inherited. The type of cancer inherited in families, including breast, ovarian, prostate, or colon (large intestine).

b. Cancer Symptoms

Supriyanto [40] explained that in the early stages, usually cancer causes no symptoms. Symptoms of new cancer appear

when it has been grown to be large and compress the surrounding organs. However, there are some common symptoms that usually get worse over time bad include:

1. Pain or pain that often comes and gets worse and is difficult to treat, which is an advanced stage system of cancer.
2. Frequent fever that is seen in advanced stages, especially when Cancer affects the immune system and reduces defense against infection.
3. Excessive fatigue.
4. Changes in skin color, resulting in yellowing, redness, itching, or excessive hair growth.
5. Changes in bowel or bladder habits.
6. Changes in skin color of the body or face that persist (yellow, red, or brown).
7. Significant weight loss (above 10 kg) over a period of time short (months) for no apparent reason.

c. Patofisiology

Sukardja (41), describes all cells, both normal and cells Cancer divides in a cell cycle. However, normal cells in the body are in balance between the speed of these cells to divide and form new cells at the rate of cell death. In general, the cells in the body are divided into 3 groups, namely:

a) Actively proliferating cell groups

b) Differentiated cell groups

c) Groups of cells that are not actively proliferating (G0) that can enter the cell cycle with a certain stimulation.

Each cell begins its growth during the post-miotic phase (G1) where enzymes are essential for the production of DNA, RNA, and

other proteins produced. This phase is followed by the DNA synthesis (S) phase. after DNA synthesis Once complete, the cell enters the pre-mitotic phase (G2) where protein and synthesis occur more RNA. This phase is followed by the mitotic phase (M) where cell division occurs, one cell will divide into two cells. The cell then enters the phase G1 is back. Cells that are in the G1 phase can enter the resting phase (G0).

Cancer arises from genetic lesions that cause growth or excessive cell division that is not accompanied by excessive cell death adequate. Failure of cellular differentiation causes changes in cellular position and the capacity to proliferate. Normally, the cells will be stimulated to enter the cell cycle from G0 or remain in the cell cycle under the influence of certain signals such as growth factors, cytokines, and hormones. The cell then enters the G1 and S phases after passing through the checkpoints for ensuring that the gene is ready to replicate. Kinase enzymes Cyclin-dependent kinases (CDKs) are enzymes that play a role in regulating the passage of cells into each phase of the cell cycle. One point The most important test so that cells can enter the S phase is regulated by the product of the p53 tumor suppressor gene. The product of this gene is CDK 4 and 6 inhibitors. Activated CDK 4 and 6 enzymes will phosphorylate retinoblastoma gene product (pRb). Phosphorylated pRb will release E2FS which plays a role in completing DNA replication during the S phase G2, CDK2 together with cyclins A and E ensure that the synthesis of The correct DNA is complete. The next cell will enter the M phase under the effect of CDK1 and cyclin B.

Cancer cell proliferation is also regulated by proto-oncogenes that are in the state active will cause cell growth. Oncogenes can be divided into 2 groups, 1) oncogenes that act in the cytoplasm to interfere with factors. signaling normal growth, ras, raf, and

tyrosine kinase enzymes from src, erbB tau sis; 2) nuclear oncogenes, which alter gene transcriptional controls, such as jum, fos, myc, and myb. Tumor suppressor genes, such as p53 and pRb, act to inhibit or prevent the occurrence of irregular cell growth due to the activity the proto-oncogene. Furthermore, the cell's capacity to divide is regulated by telomerase activity which regulates chromosomal replication. Invasion capacity and Metastases are affected by the cooperation of metalloproteases to attract cells to the host stroma at the site of invasion via tumor-induced angiogenesis.

2.4.2 Non-cancer risk of smoking

Non-cancer diseases related to smoking are diseases caused directly by smoking or made worse by smoking. Diseases that cause death for smokers include:

a. Coronary heart disease.

Every year approximately 40,000 people in the UK aged under 65 years of age die from a heart attack and about three-quarters of this number of deaths is due to smoking habits. Smoking affects the heart in various ways. Smoking can raise blood pressure and speed up the heart rate so that the supply of acid is less than normal which is necessary for the heart to function properly. This situation can be burdensome cardiac muscle work. Smoking can also cause the walls of blood vessels to thicken gradually making it difficult for the heart to pump blood.

b. Coronary thrombosis.

Coronary thrombosis or heart attack occurs when a blood clot closes one of the main blood vessels supplying the heart resulting in the heart being deprived of blood and sometimes stopping it altogether. Smoke makes the blood thicker and easier to clot. Nicotine can interfere with normal and regular heart rhythms resulting in sudden death result of a heart attack without warning

and is more common in people who smoke than those who don't smoke.

c. Bronchitis or inflammation of the larynx.

Cough suffered by smokers is known as the name of a smoker's cough which is an early sign of bronchitis that occurs due to the lungs being unable to release the mucus contained in the bronchi by normal. Mucus is a sticky liquid that is contained in a smooth tube called the tube bronchial tubes located in the lungs. This cough occurs because mucus catches flakes of black powder and dust from the inhaled air and prevents it from clogging the lungs. Mucus along with all the dirt moves through the tube bronchial tubes with the help of fine hairs called cilia. Cilia keep moving wavy like tentacles that carry mucus out of the lungs to the lung's throat. Cigarette smoke can slow down the movement of cilia and after a period of time certain will damage it completely and cause smokers to have more.

d. Diabetes

Patients who have a smoking habit need drops more insulin than patients who do not smoke This is because smoking has slowed the work of blood flow in the blood skin and causes slow absorption of insulin into the blood making the effectiveness of insulin work in the blood itself becomes reduced. Various studies and trials in patients with type 2 diabetes who are generally accustomed to smoking prove the percentage of their chances of getting coronary heart disease, in blood vessels. Infections in muscles and the like, higher compared to those who do not smoke likewise the possibility suffer from diabetes for those who smoke are generally higher than those who do not smoke.

e. Reduce the effectiveness

of the drug some painkillers, depression medications, and sedatives such as valium and other drugs used to treat asthma such

as aminophelem, its effectiveness will decrease if nicotine is present in the body in large enough quantities.

f. Impact of smoking on pregnancy.

Smoking during pregnancy causes slow fetal growth and can increase the risk of Low Birth Weight (LBW). Risk miscarriage in women who smoke 2-3 times more often due to Carbon Monoxide Cigarette smoke can reduce oxygen levels.

g. Impotence.

Smoking can cause sexual decline because blood flow to the penis is reduced so there is no erection.

h. Sleep disorder

According to The Tobacco Atlas (2018), smoking can also interfere with a person's sleep frequency because the nicotine contained in smoking can cause difficulty sleep.

2.4.3 Smoker classification

Smokers are generally classified according to the number of cigarettes smoked consumed every day Sitopoe (2000), There are two classifications according to the number of cigarettes consumed, namely the Sitepoe classification and the classification of Smet. Sitepoe classification divides smokers into light smokers with a consumption amount of one to ten cigarettes per day, moderate smokers with a total consumption of eleven to twenty-four cigarettes per day, as well as heavy smokers with consumption of more than twenty-four sticks per day. This classification differs from the classification Smet (1994) who classified light smokers as smokers with consumption of 1-4 cigarettes per day, moderate smokers as smokers with consumption of 5-14 cigarettes per day, as well as heavy smokers with an amount of consumption of more than 15 sticks per day.

In addition to the classification according to the number of smokers, there is also a classification according to the number of

smokers other smoking based on the number of cigarettes consumed per day related to how long the subject had smoked throughout his life. This index is called the Brinkman Index and is calculated by the multiplication formula of the average number of cigarettes smoked in a day (in stems) over a long period of time smoked in years. Results 0-199 points in the Brinkman index categorized as a light smoker, results in 200-599 points in the Brinkman index categorized as moderate smokers, while results above 600 points in Brinkman index categorized as a heavy smoker.

Table 3 Smoker Classification

Classification/Category	Indeks Brinkman (Nusa. 2016)	Sitopoe classification (Sitepoe M.et al., 2000)	Smet classification (Nusa. 2016)	Government of Canada (2008)
Light smoker	0-199 points	1-10 cigarettes per day	1-4 cigarettes per day	1-10 cigarettes per day
Mild smoker	200-599 points	11-24 cigarettes per day	5-14 cigarettes per day	11-19 cigarettes per day
Heavy smoker	>600 points	More than 24 cigarettes per day	More than 15 cigarettes per day	More than 20 cigarettes per day

2.5 HEALTH RISK RELATED TO HEAVY METALS

Over the last several decades, factors related to the potential health impacts of heavy metal exposure have been examined in professional contexts, utilizing experimental animals and humans exposed to environmental pollution. Although the types of harmful health effects are well understood, finding thresholds for specific outcomes, such as cognitive impairment in children exposed to lead or mercury, is extremely difficult or nearly impossible due to the substantial influence of confounding factors.

Individuals may come into contact with potentially dangerous chemical, physical, and biological substances through the air, food, water, and soil. Exposure, on the other hand, does not occur just as a result of the

existence of a dangerous chemical in the environment. Contact is the critical term in the definition of exposure. The agent must come into touch with the human body's exterior barrier, such as the airways, the skin, or the mouth. Exposure is frequently characterized as a function of concentration and time: "an event that occurs when a contaminant of a given concentration comes into contact with a human at a boundary between the human and the environment for an interval of time." Cigarette smoking is a significant source of exposure to cadmium. Cadmium monitoring in the general population has revealed that cigarette smoking can result in considerable increases in blood cadmium levels, with smokers' concentrations being on average 4–5 times that of non-smokers (Jarup, 1998). Despite indications of exposure to tobacco smoke in the environment, this likely contributes little to total cadmium body load (Hossn, 2001).

Inhalation of cadmium fumes or particles can be fatal, and while immediate pulmonary consequences and mortality are infrequent, they do occur on a sporadic basis. Cadmium exposure can wreak havoc on the kidneys. The earliest indicator of a renal lesion is typically tubular dysfunction, as indicated by increased excretion of low molecular weight proteins such as 2-microglobulin and 1-microglobulin (protein HC) or enzymes such as N-Acetyl—D-glucosaminidase (NAG). Although animal research indicates that cadmium may be a risk factor for cardiovascular disease, human studies have been unable to establish this. However, a Japanese study discovered an increased risk of cardiovascular death among cadmium-exposed patients with tubular kidney disease compared to those without kidney damage. Another example of heavy metal is lead. Acute lead poisoning symptoms include headache, irritability, gastrointestinal pain, and different nervous system problems. Sleep deprivation and restlessness are common symptoms of lead encephalopathy. Children may experience behavioral challenges, learning difficulties, and difficulties with concentration. Severe cases of lead encephalopathy can result in acute psychosis, confusion, and decreased awareness. Individuals who have been exposed to lead for an extended period of time may experience memory loss,

a longer reaction time, and a diminished capacity to comprehend. Individuals with an average blood lead concentration of less than 3 mol/l may have peripheral nerve symptoms such as decreased nerve conduction velocity and diminished cutaneous sensation. Severe neuropathy may result in a permanent lesion. A dark blue lead sulphide line is visible at the gingival edge in the classical illustration. In less severe cases, the most evident sign of lead poisoning is a disruption in hemoglobin production, and prolonged exposure to lead may result in anemia. A recent study indicates that chronic low-level lead exposure in youngsters may also impair their intellectual function.

Smoking is the act of burning tobacco and then inhaling it through a cigarette or a pipe. The temperature of a lit cigarette is 90 degrees celsius at the tip and 30 degrees celsius at the tip tucked between the smoker's lips. When tobacco is heated, moisture and volatile matter are distilled, and combustion produces volatile gases and residual carbonized char. During puffing and burning, char combines with oxygen in the air, creating volatile gases (carbon dioxide, carbon monoxide, and water) and the inorganic residue known as ash. Inhalation is the primary method of exposure for smokers that poses harm to the human body. Inhaled particles of the size present in tobacco smoke would be expected to deposit mostly in the alveolar region of the lung, causing damage not just to the lung but also to other organs such as the heart.

Table 4 Non-cancer risk for smokers

Country (Ref.)	Population	Lead	Cadmium	Result
Nigeria (Benson et al., 2017)	Nigerian adult	1.25E + 00	4.66E-01	HI=3.58E + 00
Singapore (Sailesh, et al., 2014)	Active smokers	1.5×10^{-4}	2.1×10^{-5}	$HI_{Pb} = 6.5 \times 10^{-3}$ $HI_{Cd} = 4.6 \times 10^{-3}$
Austria (Viachou, et al., 2021)	Austrian smokers aged 15 and older	-	0.22 $\mu g/m^3$	HQ= 11.0

Taiwan Cheng, et al., 2019	Smokers	2.12×10^{-4}	4.77×10^{-3}	$HQ_{Pb}=1.42 \times 10^{-4}$ $HQ_{Cd=} 4.77 \times 10^{-1}$

Table 5 Cancer risk for smokers

Country (Ref.)	Population	Lead	Cadmium	Result
Nigeria (Benson et al., 2017)	Nigerian adult	5.37E-01	2.00E-01	3.00 E-03
Singapore (Sailesh, et al., 2014)	Active smokers	0.012	1.8	$_{pb=}2.1 \times 10^{-8}$ $_{Cd=}1.7 \times 10^{-7}$
Austria (Viachou, et al., 2021)	Austrian smokers aged 15 and older	-	7.5E–04	7.5E–04
Taiwan Cheng, et al., 2019	Smokers	2.12×10^{-4}	4.77×10^{-3}	$_{Pb}=1.2 \times 10^{-5}$ $_{Cd=} 4.2 \times 10^{-3}$

Smoking is the leading risk factor for a variety of cancers, most notably lung, head, and neck cancer. On the basis of sufficient evidence in humans and experimental animals, the IARC categorized cadmium as a human carcinogen (group I) and lead as a potential human carcinogen (category B2) (1993). The IARC cautioned, however, that the evaluation was based on a small number of studies of lung cancer in occupationally exposed populations, frequently with imprecise exposure data, and without the ability to account for probable confounding effects of smoking and other associated exposures (such as nickel and arsenic). Cadmium has been linked to prostate cancer, but there has been both positive and negative research published. Early evidence suggested a link between cadmium exposure and kidney cancer. The higher cardiovascular mortality associated with the non-cancer risk effect has been related to elevated blood lead levels in the general population in the United States (Lanphear, 2018 & Lustberg, 2002). Blood cadmium has also been proven to be a significant predictor of all-cause and CVD mortality, as well as an increased risk of peripheral artery disease and hypertension (Tellez et al., 2012).

Toxic metals like lead and cadmium pose serious risks to human health. Toxicity of these agents is evidenced by both lead and cadmium being identified in the top 10 environmental hazards by the Agency for Toxic Substances and Disease Registry (ATSDR, 2005). In fact, toxic metals such as aluminium, cadmium, chromium, copper, lead, mercury, nickel, and zinc are found in tobacco, cigarette paper, filters, and cigarette smoke but the research that conducted by Bernhard, D (2015), found that only Cd, Pb, and Cr that are categorized as hazardous when compared to Al, Mn, Ni, Hg, V which are classified as non-hazardous for human health. This is in line with the research from Benson (2017) evaluated the concentrations of cadmium (Cd), copper (Cu), iron (Fe), manganese (Mn), lead (Pb), and zinc (Zn) in 10 branded cigarettes shows the result that human cancer risks posed by Cd and Pb and non-carcinogenic risk estimates for Cd and Pb were greater than 1.0 (HI > 1) while the other heavy metals are not included in both. In addition, tobacco is an important contributor to cadmium exposure. Cadmium is the metal that has been examined the most in relation to cigarette smoke. So that we can conclude cigarette smoking is the primary way in which humans consume cadmium (ATSDR, 2012). Cd in particular is regarded by the International Agency for Research on Cancer (IARC) as one of the “strong carcinogens” in tobacco smokers (Hecht, S. 2012). It is also proven by Satarug et al. (2004) research found that smokers had a 1.7-fold higher serum Cd level than nonsmokers.

Lead is present in tobacco smoke and contribute significantly to cancer risk indices (Fowles, 2003). Source from the literature review (Dinh, et al., 2021), shows that the cigarette sample from Indonesia had the highest Pb concentration of 14.5 µg/g if compare to Cd and Hg in many countries such as Korea, Vietnam, Japan, Italy, Thailand, and UK. Furthermore, Biomonitoring studies show that smokers have substantially higher Cd and Pb levels (Richter et al., 2009), and bioaccumulation of metals has also been demonstrated in those chronically exposed to tobacco smoke pollution also known as second-hand smoke (Serdar et al., 2012). Because the use of

arsenic-containing pesticides has declined, smoking no longer appears to represent a major exposure pathway for As (Marano et al., 2012). That is why Pb and Cd should be concerned and do health risk assessment.

CHAPTER III
RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

The study was designed as a cross-sectional study and a quantitative descriptive research method in the city of Surakarta. An online questionnaire was used to explore the information on the respondent's characteristics (age, body weight, height, education, occupation, underlying disease) and exposure factors (duration per day, frequency per day, amount of cigarette per smoke). Moreover, the respondent's data was collected in May-June 2022.

3.2 LOCATION OF RESEARCH

3.2.1 Research location

This research will conduct in the city of Surakarta located in the south of Indonesia in Central Java. The total population of 562,269 people obtained a population density of 12,767 people per km^2 with the rate of smoking 19.16% (Riskesdas, 2018). This city is also the third-largest city in the southern part of Java Island.

Figure 2 Map of Surakarta

Source: Indonesian Information Portal

Figure 3 Map of Study Area

3.3 RESEARCH POPULATION AND SAMPLE

3.3.1 Research population

A cross-sectional was conducted in order to obtain information on exposure to heavy metals in cigarette smoking by asking a questionnaire to 327 respondents who are smoking Indonesian local cigarettes. The targeted population in this study were smokers within the age range of 20-35 years male residents in Surakarta, Indonesia because the higher cigarette consumption that showed by Riskesdas, 2018. The data from Riskesdas 2018 shows, 19,16 % of daily smokers in Surakarta city with the group age 20-24, 25-29, 30-35 are 26.77%, 29.55%, 30.17% in Central Java respectively. Furthermore, smokers whom were considered as targeted population only if they were smoking Indonesian local cigarette at least 6 monhts because it was to emphasize that respondents are still exposed to heavy metals, according to Australian Smoking Cessation Guidelines if smokers

don't smoke for 6 months, body condition, especially lungs, will get better without exposure to cigarettes (Zwar et al., 2012).

3.3.2 Inclusion and exclusion criteria

1. Inclusion criteria

- Male Indonesian smokers who smoke the local Indonesian cigarette.
- Age range, Adult $\geq$ 20-35.
- People who smoke > 6 months.

2. Exclusion criteria

- Participant who does not want to participate.
- People who already have or ever have cancer.
- People who cannot speak, read, or write Bahasa.

3.4 SAMPLE SIZE CALCULATION

$$n = \frac{N}{1 + N(e^2)}$$

$$= \frac{1167}{1 + 1167\ (0{,}05)^2}$$

$$= 297.89 = 298 + 10\% = \mathbf{327}$$

n = Sample size

N = Population size

e = Margin of error

Based on the formula of Yamane (1967:886), a sample of 327 respondents was obtained. With confidence level of 95%. The sample in this study was taken by the technique of Slovin calculation. The population from the national survey 2018 obtained 1167 people who smoke lived at Surakarta city (Riskesdas, 2018).

3.5 METHOD OF COLLECTING DATA

The study conducted during May-June 2022. A sample collection questionnaire (online questionnaire) was used for collecting data. Questionnaires was distributed by the researcher to respondents who meet

inclusion/exclusion criteria to complete. The questionnaire was sent or distributed using a google form to reach respondents in Surakarta, Indonesia. In this study that used a larger group or population which is the whole of Surakarta, a sample random sampling is suitable to prevent bias and reduce the time used. After the respondent has successfully entered the google form link, then they must fill out a screening questionnaire first and have an answer according to the respondent's criteria to be able to proceed to the main questionnaire.

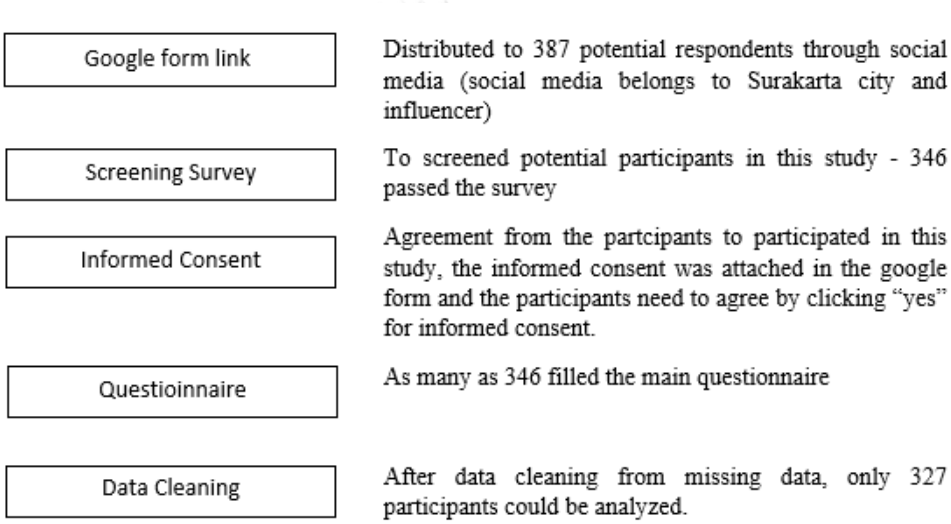


Figure 4 Steps of data collection

3.6 MEASUREMENT

The study was using questionnaires as a measurement tool. There are 2 questionnaires that used, screening questionnaire and questionnaires that consist of socio-demographic characteristics (Age, Bodyweight, Height, Education, Occupation, Underlying disease), smoking behavior (Duration per day, Frequency per day) from the participant.

3.6.1 Screening questionnaire

The screening questionnaire consisted the basic questions such as living location, ages, gender, and disease. This screening questionnaire aims to screen respondents before proceeding to the next questionnaire which is the main questionnaire, making it easier for researchers to

select respondents, if the respondent's answer is "no" then they cannot proceed to the main questionnaire.

Table 6 Screening survey for data collection

No	Questions	Answer
1	Do you smoke?	☐ Yes ☐ No (end screening questionnaire)
2	Are you 20-35 years?	☐ Yes ☐ No (end screening questionnaire)
3	Do you live in Surakarta?	☐ Yes ☐ No (end screening questionnaire)
4	Do you have cancer?	☐ Yes ☐ No (end screening questionnaire)

3.6.2 Smoking Cigarette Measurement

The main questionnaire consisted of socio-demographic and measurement of smoking cigarettes which was carried out using the help of a questionnaire.

Part 1: **Socio-demographic** information of smokers such as Age, Gender, Bodyweight, Height, Education, Occupation, Underlying disease were obtained.

Part 2: **Smoking behavior** such as duration per day, frequency per day, length of smoking, how many cigarette used a day.

The procedure for examining smoking cigarettes in this study is as follows:

a. Explain the examination procedure to the respondent and encourage them to fill in the questionnaire questions.
b. In the explanation process, the researcher will write all the detailed information on the google form such as research information and research benefits that can encourage respondents to participate in filling out the questionnaire.
c. Give detailed information on the questionnaire information such as the duration and the frequency of smoking.

3.7 VALIDITY & RELIABILITY

The questionnaire has been validated by experts who were 2 public health from Thailand and 1 health Indonesian lecturer based on the Item Objective Congruence (IOC) average score 1. The results from experts with the interpretation -1 means the item is not consistent, 0 means the item corresponds to the section definition, study title, and objectives but wordings are not clear, 1 means the wordings are clear and content of the item is consistent with the study title and objectives. After the revision, the questionnaire was reviewed by all experts for confirmation. The validated questionnaire translated into Bahasa as Indonesian language. Prior to actual data collection, pilot test was conducted in 30 samples which are 10 percent of the total sample size from the study area. The results of reliability test by Cronbach's Alpha 0.89 using SPSS version 22.

3.8 DATA ANALYSIS

3.8.1 Data entry and statistical analysis

Data processing is carried out with the following steps: (1) editing, carried out to check the accuracy and completeness of the data; (2) coding, the data that has been collected is corrected, then coded by the researcher manually before being processed by the computer; (3) entry, the data is entered into a computer program; (4) data cleaning, checking all data that has been entered into the computer in order to avoid errors in data entry; (5) saving, data storage to be ready for analysis; and (6) data analysis (Wahyuni, 2007).

a) Descriptive statistics consist of two types: categorical data e.g., frequency (n) and percentage (%), and continuous data e.g., mean, standard deviation (SD), median.

b) Normality test used kologorov-Smirnov and Shapiro-Wilk for general characteristics (age, education, occupation, gender, etc), exposure factors (duration per day, frequency per day, length of smoking, how many cigarette used a day). Result of mean used if the data normally distributed, and median used if the data not

normally distributed. The mean or median used as a cut off point for data categorization (chi-square).

c) Chi-square test (CI 95%)

Initially, the bivariate analysis will be used to identify factors such as age, education, occupation, height, weight, etc (independent variables) associated with cancer & non-cancer risk (dependent variables). *Bivariate analysis* is an analysis that is performed to determine the relationship between 2 variables. In this research used Chi-Square test because the data outcome is categorical. As it was using chi-square test so the cutoff point should be used which was resulting categorical data coded as 1 and 2. Characteristics with p-value <0.05 considered as significant result with association of the dependent variable.

3.8.2 Steps of health risk assessment

a. Step 1 Hazard identification

The risk assessor examines whether a stressor has the potential to cause harm to humans and/or ecological systems and if so, under what circumstances. Scientists find out the hazard by evaluating all available information regarding the effects of toxic pollutants. If scientists get valid evidence then scientists are increasingly convinced that toxic pollutants cause certain health problems. Statistical studies of the number of cases or certain diseases are often carried out to prove to humans. Human information is very limited for most toxic pollutants therefore, researchers often conduct studies that are conducted on an animal test. The results of this study are used to estimate the effects of toxic pollutants on humans.

In this study, lead and cadmium will be analyzed which have high concentrations in tobacco smoking. Pb or lead is considered as a non-cancer risk which is proven to have an effect on Neurological symptoms, IQ deficits, effects of blood pressure and

kidney. Pb has been classified as a Group B1 - Probable Human Carcinogen. This classification was based on animal studies showing an increased risk of kidney tumors and inadequate human evidence. Whereas cadmium contributed to non-cancer effects such as respiratory effects, such as bronchitis, emphysema, and kidney. Cadmium also contributed to cancer risk which has been classified as a group I carcinogen.

b. Step 2 Dose-response assessment

In this step, the risk assessor(s) examine what is known about the frequency, timing, and levels of contact with the stressor. This is an evaluation of the relationship between the amount of exposure to toxic substances it is generally assumed that no exposure has zero risk that even very low exposure to cancer-causing pollutants can increase the risk of cancer.

The dose-response relationship for non-cancer effects was calculated differently than for cancer effects. For non-cancer effects, very low doses may not harm human health. Threshold values were developed for non-cancer-causing chemicals. Doses below the threshold are considered "safe" and doses above the threshold are considered dangerous.

Table 7 Slope Factor and Reference Concentration of Inhalation route

Heavy Metals	Slope Factor	Reference Concentration	References
Pb	1.20E−05 µg/m^3	2.0E-05 mg/m3	California EPA inhalation unit risk, OEHHAc, 2009
Cd	1.8E-03 (µg/m3) $^{-1}$	2.0E-05 mg/m3	US EPA, 2000; CalEPA, 1999b

c. Step 3 Exposure assessment

The risk assessor collects information to determine a numerical relationship between exposure and effect. Exposure assessment is

the second step of risk assessment and is used to determine how much of a toxic pollutant people are exposed to and/or how many people are exposed. There are 3 ways of exposure through ingestion, inhalation, and absorption through the skin. Exposure is investigated by taking air, water, and soil samples and conducting an analysis directly in the field or in the laboratory which will show the results of the concentration of toxic pollutants present at a certain level of location. In addition, the pathway of exposure is also evaluated as well as how certain pollutants from certain sites reach people (U.S EPA, 1992).

So basically smoking cessation is mainly using the inhalation exposure route to humans, when the human body is exposed to cigarette smoke. But it is not necessarily being the first majority of human exposure that contributed to both cancer risk and non-cancer risk. The most critical substances in one-off (high) exposure to substances in smoke from a fire are the substances that influence breathing and the highly irritant substances. Inhalation is a major route of exposure that occurs when an individual breathes in polluted air such as smoke of cigarette which enters the respiratory tract. Identification of the pollutant uptake by the respiratory system can determine how the resulting exposure contributes to the dose. In this way, cigarette smoke can be inhaled, or simply exhaled from the mouth, as is generally done with pipes and cigars, which means that the most common route of tobacco use is via inhalation (SAMSHA, 2005).

The average daily dose (ADD) U.S EPA (1992) is used to measure the dose. The equation for calculation is:

$$\mathbf{ADD} = \frac{\mathbf{C_{air}} \times \mathbf{I_{nh}R} \times \mathbf{ET} \times \mathbf{EF} \times \mathbf{ED}}{\mathbf{BW} \times \mathbf{AT}}$$

ADD = Potential average daily dose (mg/kg-day).

C_{air} = Contaminant concentration in inhaled air (mg/m^3)

InhR = Inhalation Rate (m^3/day)

ET = Exposure time (hours/day)

EF = Exposure frequency (days/year)

ED = Exposure Duration (years)

BW = Body weight (kg).

AT = Averaging time (days), for non-carcinogenic effects AT = ED, for carcinogenic AT = 70 years or 25,550 days (lifetime) (US EPA, 1992).

Table 8 Exposure Parameters

Parameter	Symbol	Unit	Value		References
			Default value from US EPA	Questionnaire	
Contaminant concentration in air	C_{air}	mg/m3			(Huwaida, 2016)
Inhalation rate	InhR	mg/hours	0.83		Indonesian Ministry of Health (2012)
Exposure time	ET	hours/day		*	US EPA 1992
Exposure frequency	EF	days/year		*	US EPA 1992
Exposure duration	ED	years		*	US EPA 1992
Body weight	BW	Kg		*	US EPA 1992
Averaging time	AT	Days	Carcinogens	Non-carcinogens	US EPA 1992
			365 x lifetime	365 x ED	

* Data was obtained from questionnaires

d. Step 4 Risk Characterization

All of the processes are to help the scientists to estimate the extra risk to human health or the environment that is caused by toxic pollutants. Risk information can be presented in different ways to describe how individuals or populations may be affected. Ways that risk can be communicated include the Maximum Individual Lifetime Cancer Risk - the estimated increased lifetime cancer risk for individuals exposed to the maximum predicted long-term concentrations. The way to calculate from U.S. EPA

(1994) between carcinogenic and non-carcinogenic has different calculations.

Cancer risk = LADD x IUR and,

Non-Cancer risk = ADD / RfC (Reference Concentration)

The interpretation of the results of the calculation is, that when Hazard Index (HI) < 1, therefore there is no risk for both carcinogenic and non-carcinogenic. The level of cancer risk that is of concern is a matter of individual, community, and regulatory judgment. However, the EPA typically considers risks below 1 x 10-6 to be so small as to be negligible. Therefore, the EPA uses a cancer risk of one in a million (1 x 10-6) as a regulatory goal, which means that regulatory programs are generally designed to try to reduce risk to this level. However, the EPA considers all cancer risks lower than 1 in 10,000 (1x10-4) to be “acceptable”.

"Risk estimation" compares:

- The estimated or measured exposure level for each stressor and plant or animal population, community, or ecosystem of concern; and
- The data on expected effects for that group for the exposure level.

"Risk description" provides information important for interpreting the risk results. This includes:

- Whether harmful effects are expected on the plants and animals of concern;
- Relevant qualitative comparisons; and
- How uncertainties (data gaps and natural variation) might affect the assessment (EPA, 2005).

3.9 OBSTACLE AND STRATEGIES TO OVERCOME

There are a few obstacles that researcher face such as, researchers had difficulties in collecting data through questionnaires during the data collection process, but then researchers chose another method by targeting universities located in the Surakarta city area.

3.10 FLOW CHART OF THE METHODOLOGY

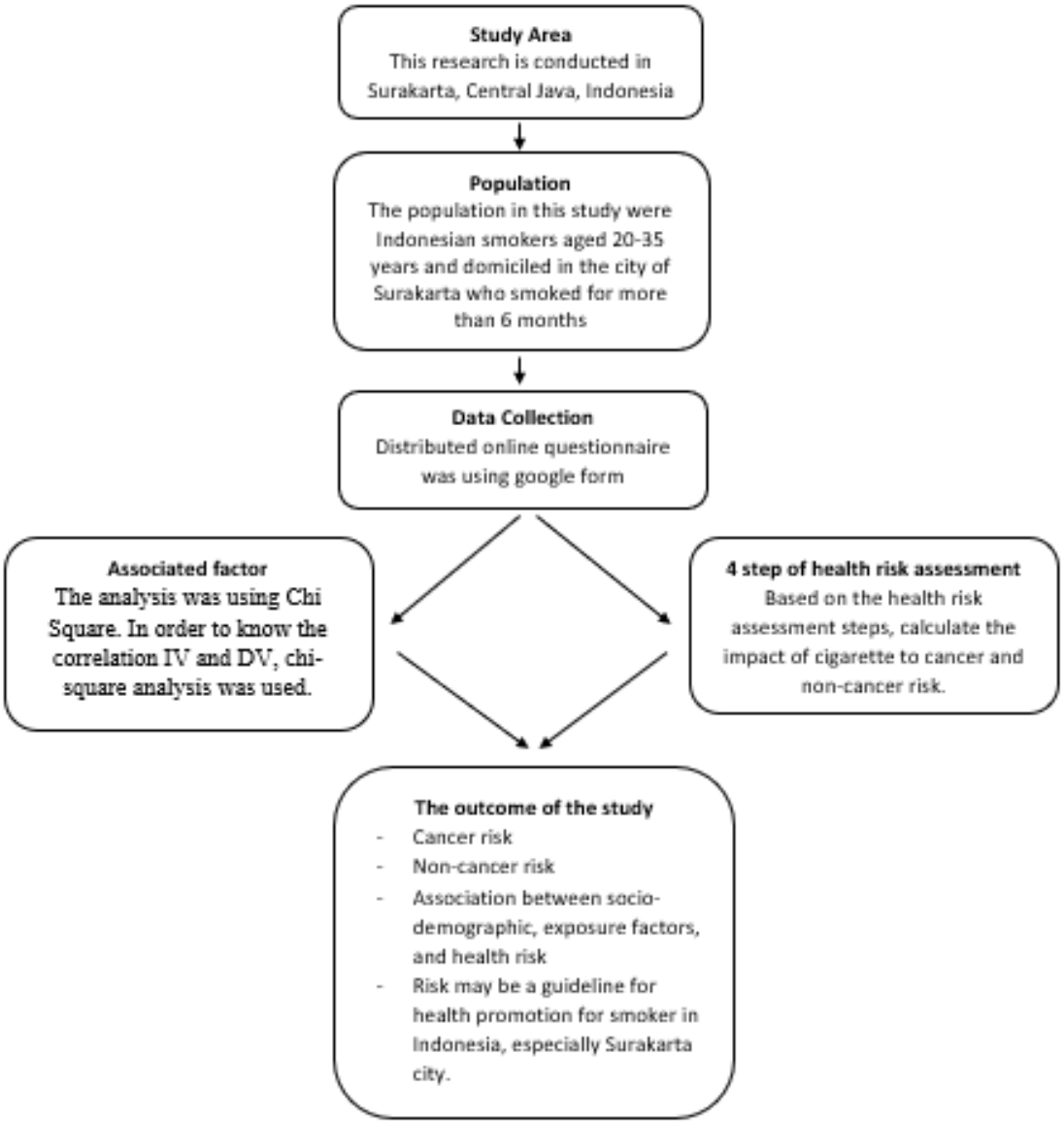


Figure 5 Flow Chart

3.11 RESEARCH ETHIC

This research was approved by the Research Ethics of Institutional Review Board, an independent institution within the Faculty of Medicine, University of Muhammadiyah Jakarta, Indonesia No. 070/PE/KE/FKK-UMJ/IV/2022.

CHAPTER IV
RESULT

The results are divided into 4 parts, the first part contains the characteristics of respondents and important information such as age, weight, height, education, occupation, and underlying diseases. The second part contains about the non-cancer risk of cadmium and lead that explained The results of Hazard Quotient (HQ) and Hazard Index (HI). The third part contains about cancer risk of cadmium and lead that compare the research result to the acceptable risk level from US EPA (1×10^{-6}). While, the last part explained the association between socio-demographic characteristics and exposure factors towards non-cancer risk and cancer risk of cadmium and lead.

4.1 Characteristics of respondents

Research has been carried out in the city of Surakarta with a sample of male smokers aged 20-35 years as many as 327 subjects. In the data collection process, the majority of the results were adapted according to the inclusion and exclusion criteria in this study, but there were also some participants who did not meet the criteria so they had to be eliminated. The characteristics of the respondents in this study included age, weight, height, education, occupation, and underlying diseases.

a. Characteristics of respondents based on age, weight, height, education, occupation, and underlying diseases.

Table 9 Frequency Distribution of Respondent's Characteristics

Characteristics (N=327)		
Age (years)	Mean ± SD	23.96 ± 3.63
	Median	23.00
	Min-max	20-35
Weight (kg)	Mean ± SD	62.48 ± 10.59
	Median	60.00
	Min-max	34-128
Height (cm)	Mean ± SD	168.30 ± 6.39
	Median	169.00
	Min-max	150-189
Smoking (Cigarettes/day)	Mean ± SD	7.85 ± 5.47
	Median	7.00

	Min-max	1-50
Smoking duration (minutes)	Mean ± SD	14.76 ± 14.64
	Median	10.00
	Min-max	1-120
Smoking Frequency in a day	Mean ± SD	4.47 ± 2.71
	Median	4.00
	Min-max	1-20
Smoking duration (years)	Mean ± SD	3.18 ± 2.56
	Median	2.50
	Min-max	0.42 - 20
Working Place	Indoor	193 (59%)
	Outdoor	134 (41%)
Education	Lower than Primary School	1 (0.3%)
	Primary School	26 (8%)
	High School	135 (41.3%)
	Bachelor	156 (47.7%)
	Higher than Bachelor	9 (2.8%)
Occupation	Government Officer	16 (4.9%)
	Student	111 (33.9%)
	Merchant	36 (11%)
	Officer	109 (33.3%)
	Labor	34 (10.4%)
	Entrepreneur	20 (6.1%)
Underlying Disease	None	297 (90.8%)
	Diabetes	18 (5.5%)
	CVD	5 (1.5%)
	Others	7 (2.1%)

Three hundred twenty-seven subjects were included in the study. The mean age and standard deviation were 23.96 and 3.63 years, respectively. When viewed from the age group of respondents, most of them are in the age group of 20-25 years, with a percentage of 72.2%, as many as 236 people. The results of their weight and height characteristics of the mean and standard deviation were 62.48 ± 10.5 kg and 168.30 ± 6.39, respectively.

The average daily smoking rate of tobacco cigarettes was 7.85 cigarettes/day. The average smoking duration was 3.18 years with the smoking frequency 4.47 times a day. While the average smoking duration was 14.76 minutes a day. According to Riskesdas, (2018), the

result of cigarette consumption was slightly different, the mean average daily smoking of tobacco cigarettes was 10.62 cigarettes/day and 8,19 cigarettes/week. The average cigarette consumption based on ages 20-24, 25-29, 30-34 were 10.47, 10.99, 11.50, respectively (Riskesdas, 2018).

Based on the Smet's classification (Nusa. 2016), which explains the classification of smokers by dividing into 3 groups, if a smoker spends 1-4 cigarettes per day, they categorized as a light smoker, 5-14 as a mild smoker and more than 15 cigarettes per day as a heavy smoker. In this study, from 327 respondents, it was found that more than half or 211 were smokers in the mild smoker category (64.5%), as many as 85 respondents (26%) were categorized as light smokers and as many as 31 respondents (9.5%) belonged to the category of a heavy smoker.

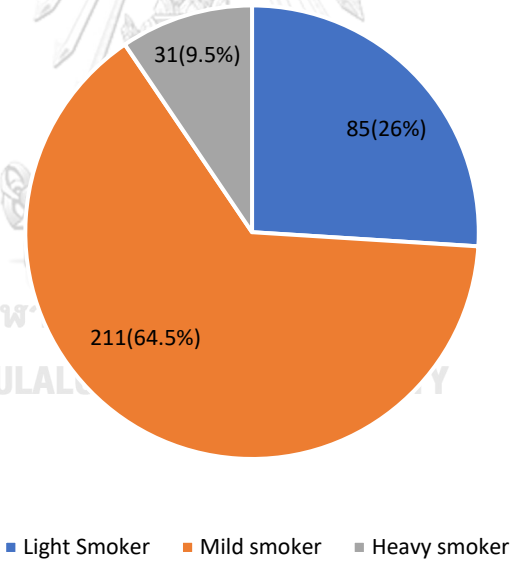


Figure 6 Smoker Classification

Most of the respondents work indoors with a percentage of 59%. The two most common occupations of respondents were students (33.9%) and officers (33.3%). Based on the data from Surakarta Health Profile, (2020), labor and employee were the two most common

occupations in Surakarta city. From the level of education taken, many respondents have a bachelor's education level with a percentage of 47.7%, this education result is different from the Surakarta Health Profile which shows a higher proportion for high school level. A total of 297 respondents do not have congenital diseases, but some respondents have diseases such as cardiovascular diseases, diabetes, and others.

4.2 Non-cancer risk of cadmium and lead

Human risk assessment was performed to estimate non-cancer risk and cancer risk of heavy metals exposure via the inhalation route. The mean daily intake (ADD) for inhalation exposure to each heavy metals Cd and Pb for non-cancer risks calculated through the ADD equation. In this calculation, all the factors value that were used to calculate non-cancer risk showed on the table below.

Table 10 Non-cancer calculation

Parameter	Symbol	Unit	Values		References
			Default value/ other sources	Questionnaire	
Contaminant concentration in air	C_{air}	mg/m3	0.17		Research
Inhalation rate	InhR	mg/hours	0.83		Ministry of Health (2012)
Exposure time	ET	hours/day		*	US EPA 1992
Exposure frequency	EF	days/year		*	US EPA 1992
Exposure duration	ED	years		*	US EPA 1992
Body weight	BW	kg		*	US EPA 1992
Averaging time	AT	days	365 x ED		US EPA 1992

* Data was obtained from questionnaires

Furthermore, the HQs for all inhalation exposure were summed in order to obtain the HI of heavy metals in order to estimate non-cancer risks of participants. The non-cancer risk of HMs via inhalation. The result Hazard Quotient (HQ) of cadmium was higher than safe levels, while result for Pb was in the safe level. Those 2 heavy metals show the Hazard Index (HI) result 128.3 which the normal value should be less then 1. In conclusion, 327

(100%) of respondents found non-cancer risk or suggesting substantial non-cancer risks posed by heavy metals for respondents.

Table 11 non-cancer risk

	Hazard Quotient (HQ)		Hazard Index (HI)
	Cd	Pb	
Mean ± SD	128.2 ± 178.8	0.076 ± 0.10	128.3 ± 179.0
Median	72.6	0.043	72.6
Min-max	5.28 – 152.1	0.003-0.905	5.28-152.2

The non-cancer risk of HMs via inhalation. The result Hazard Quotient (HQ) of cadmium was higher than safe levels, while result for Pb was in the safe level. Those 2 heavy metals show the Hazard Index (HI) result 128.2 which the normal value should be less then 1. In conclusion, 327 (100%) of respondents found non-cancer risk or suggesting substantial non-cancer risks or might be non-cancer adverse health effects caused by heavy metals exposure.

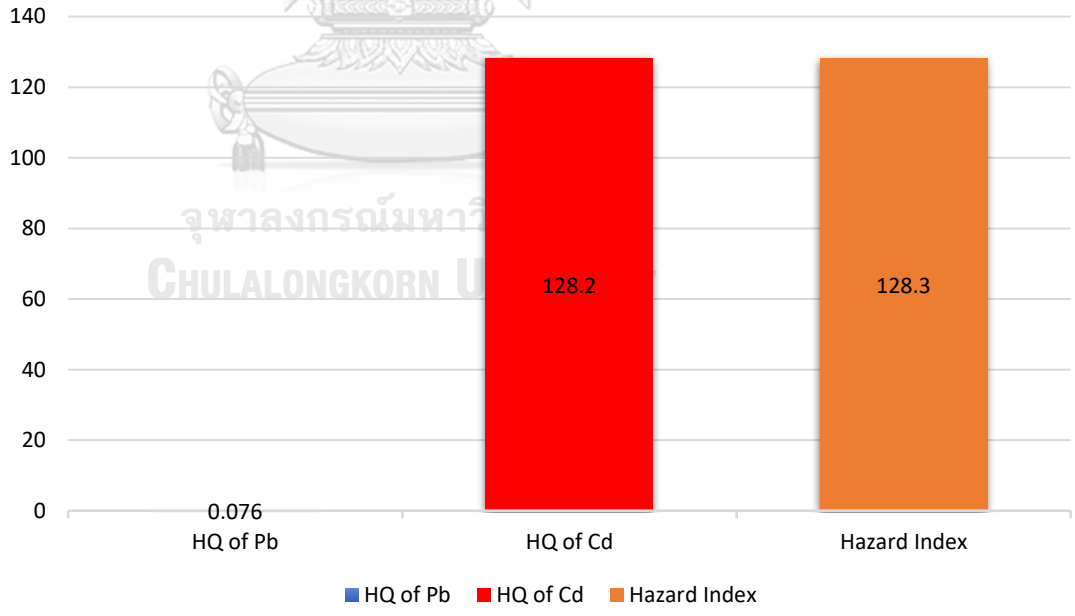


Figure 7 Hazard Quotient Results

4.3 Cancer risk of cadmium and lead

Cd, is human carcinogens (group 1) and Pb is (group II) via inhalation. The cancer risks of inhalation exposure to cadmium (Cd) and lead (Pb) were

assessed in this study. ADD for cancer risk was separately calculated by using exposure durations from table below, and lifetime cancer risks by using default exposure duration from US EPA.

Table 12 Cancer risk calculation

Parameter	Symbol	Unit	Values		References
			Default value/ other sources	Questionnaire	
Contaminant concentration in air	C_{air}	mg/m3	0.0001		Research
Inhalation rate	InhR	mg/hours	0.83		Ministry of Health (2012)
Exposure time	ET	hours/day		*	US EPA 1992
Exposure frequency	EF	days/year		*	US EPA 1992
Exposure duration	ED	years	70		US EPA 1992
Body weight	BW	kg		*	US EPA 1992
Averaging time	AT	days	365 x 25550		US EPA 1992

Table 6 presents the cancer risks of inhaling particulate Cd and Pb in personal exposure conducted by adult participants. The CR inhalation posed by personal Cd exposure via inhalation was the highest between those 2 heavy metals. The average of CR for Cd (4.62×10^{-6}) exceeded the tolerable risk limit. These results indicate ~ 5 out of one million adults living in the study area are possible to be cancer from inhaling cadmium during their lifetime.

Table 13 cancer risk of cadmium and lead

	Cancer Risk (CR)		Total Cancer Risk
	Cd	Pb	
Mean ± SD	$4.62 \times 10^{-6} \pm 6.44 \times 10^{-6}$	$1.83 \times 10^{-11} \pm 2.56 \times 10^{-11}$	$4.62 \times 10^{-6} \pm 6.44 \times 10^{-6}$
Median	2.62×10^{-6}	1.04×10^{-11}	2.62×10^{-6}
Min-max	$2.00 \times 10^{-6} – 5.48 \times 10^{-6}$	$7.55 \times 10^{-11} – 2.17 \times 10^{-10}$	$2.00 \times 10^{-6} – 5.48 \times 10^{-6}$

The average CR for Pb (1.83×10^{-11}) was lower than the acceptable risk level (1×10^{-6}). These results further exemplify the toxic effects of heavy metals on human health, suggesting that long-term personal exposure to heavy metals warrants extensive investigation and possibly remediation. In conclusion, people may get the carcinogenic effect of cigarette smoking from

cadmium exposure through inhalation which accounted for 287 (87%) of respondents, while the result of lead is still in safe value.

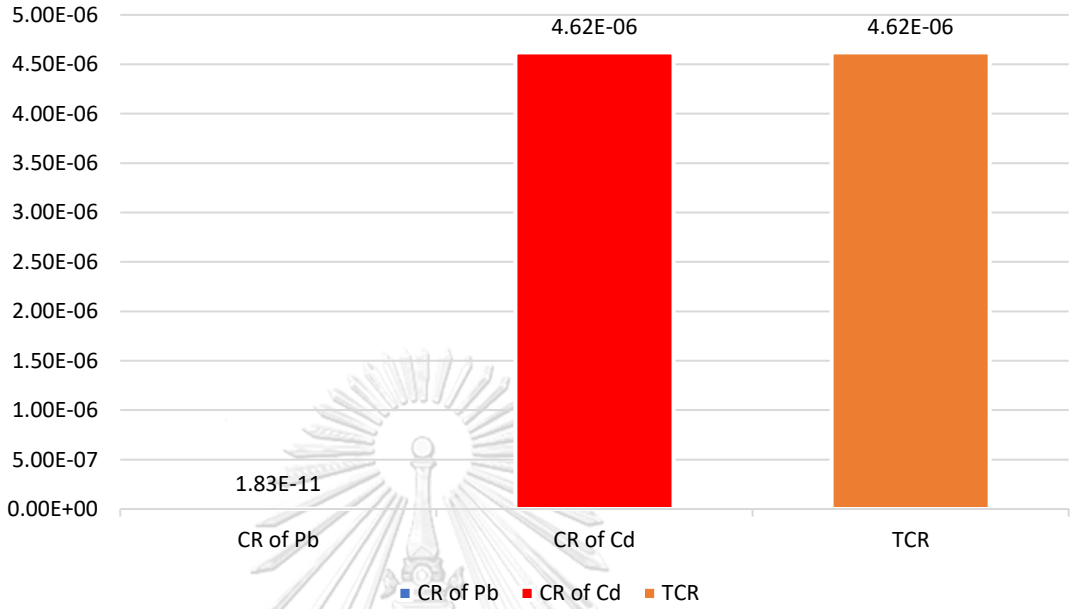


Figure 8 Cancer Risk

4.4 Associated factor

These tables below show the association of independent variables with the dependent variable, non-cancer risk of cadmium , non-cancer risk of lead, cancer-risk of cadmium, and cancer risk of lead. All independent variables are categorized into 2 groups as described in the methodology chapter. Dependent variable, non-cancer risk of cadmium is categorized into 2 groups as described in the methodology chapter. Bivariate Analysis by chi-square test was used to find the associated variables of non-cancer risk of cadmium, and the OR was also calculated. Variables with a p-value < 0.05 were considered statistically significant.

a. Associations of Socio-demographic characteristics and exposure factors towards non-cancer risk of cadmium

The results of the Chi-square test showed a significant association of 4 variables from weight, number of cigarette smoking per day, smoking times, and smoking duration (minutes). From the weight result, compared to participants with lower weight, those with higher weight are 45.4% less

likely to have higher risk of non-cancer risk of Cadmium. (OR = 0.546, 95% CI = 0.352, 0.847). For cigarette amount, compared to participants with smoking of 1-7 cigarettes per day, participants with smoking of 8-50 cigarettes per day are 2.547 times more likely to have higher risk of non-cancer risk of Cadmium (p value < 0.001, OR = 2.547, 95% CI = 1.629, 3.981). For smoking times, compared to participants with 1-4 times smoke cigarette a day, participants with 5-20 times smoke cigarette a day are 4.491 times more likely to have higher risk of non-cancer risk of Cadmium (p value < 0.001, OR = 4.491, 95% CI = 2.785, 7.244). In addition, for smoking duration (minutes) compared to participants with 1-10 minutes smoke cigarette, participants with 12-120 minutes smoke cigarette are 8.167 times more likely to have higher risk of non-cancer risk of Cadmium (p value < 0.01, OR = 8.167, 95% CI = 4.889, 13.643) 8.167 (4.889, 13.643).

Table 14 Non-cancer risk of cadmium

Independent Variables	Non-cancer risk of cadmium				
	≤ Median (%)	> Median (%)	*X*2	*p-Value*	OR (95% of CI)
Age (Years)			0.724	0.395	
20-23	48.6	51.4			1 (reference)
24-35	53.3	46.7			0.828 (0.536, 1.279)
Weight (kg)			7.349	**0.007****	
34-60	43.3	56.7			1 (reference)
61-128	58.3	41.7			0.546 (0.352, 0.847)
Height (cm)			2.201	0.138	
150-169	54.7	45.3			1 (reference)
170-189	46.5	53.5			1.390 (0.899, 2.148)
Education			0.513	0.474	
Lower than High School	48.8	51.2			1 (reference)
Bachelor and higher	52.7	47.3			0.853 (0.553, 1.317)
Occupation			0.027	0.869	
Government officer, Students, Merchant.	50.3	49.7			1 (reference)
Private officer, Labor, Entrepreneur, Others.	51.2	48.8			0.964 (0.625, 1.487)
Diseases			1.127	0.288	
No disease	49.8	50.2			1 (reference)
Have disease	60.0	40.0			0.662 (0.308, 1.423)
Cigarette per day			17.131	**<0.001****	

(number)					
1-7	61.4	38.6			1 (reference)
8-50	38.4	61.6			2.547 (1.629, 3.981)
Smoking duration (years)			2.926	0.087	
0.50-2.50	55.4	44.6			1 (reference)
2.67-20	46.0	54.0			1.462 (0.946, 2.260)
Smoking (Times)			41.188	**<0.001****	
1-4	65.0	35.0			1 (reference)
5-20	29.2	70.8			4.491 (2.785, 7.244)
Smoking duration (minutes)			71.661	**<0.001****	
1-10	69.9	30.1			1 (reference)
12-120	22.1	77.9			8.167 .889, 13.643)

****Means Pearson's Chi-square test and significant at p-value 0.01**

b. Associations of Socio-demographic characteristics and exposure factors towards non-cancer risk of lead

The results of the Chi-square test showed a significant association of 4 variables from weight, number of cigarette smoking per day, smoking times, and smoking duration (minutes). From the weight result, compared to participants with lower weight, those with higher weight are 46.7% less likely to have higher risk of non-cancer risk of Lead. (OR = 0.533, 95% CI = 0.343, 0.827). For cigarette amount, compared to participants with smoking of 1-7 cigarettes per day, participants with smoking of 8-50 cigarettes per day are 2.477 times more likely to have higher risk of non-cancer risk of Lead (p value < 0.001, OR = 2.477, 95% CI = 1.585, 3.869). For smoking times, compared to participants with 1-4 times smoke cigarette a day, participants with 5-20 times smoke cigarette a day are 4.593 times more likely to have higher risk of non-cancer risk of Lead (p value < 0.001, OR = 4.593, 95% CI = 2.846, 7.413). In addition, for smoking duration (minutes) compared to participants with 1-10 minutes smoke cigarette, participants with 12-120 minutes smoke cigarette are 8.369 times more likely to have higher risk of non-cancer risk of Lead (p value < 0.01, OR = 8.369, 95% CI = 5.005, 13.992).

Table 15 Non-cancer risk of lead

Independent Variables	Non-cancer risk of lead				
	≤ Median (%)	> Median (%)	*X*2	*p-Value*	OR (95% of CI)
Age (Years)			0.560	0.454	

20-23	49.1	50.9			1 (reference)
24-35	53.3	46.7			0.847 (0.548, 1.309)
Weight (kg)			7.965	**0.005****	
34-60	43.3	56.7			1 (reference)
61-128	58.9	41.1			0.533 (0.343, 0.827)
Height (cm)			1.316	0.251	
150-169	54.1	45.9			1 (reference)
170-189	47.8	52.2			1.290 (0.835, 1.992)
Education			0.683	0.409	
Lower than High School	48.8	51.2			1 (reference)
Bachelor and higher	53.3	46.7			1.833 (0.540, 1.286)
Occupation			0.28	0.867	
Government officer, Students, Merchant.	51.5	48.5			1 (reference)
Private officer, Labor, Entrepreneur, Others.	50.6	49.4			1.038 (0.673, 1.601)
Diseases			1.054	0.305	
No disease	50.2	49.8			1 (reference)
Have disease	60.0	40.0			0.671 (0.312, 1.442)
Cigarette per day (number)			16.160	**<0.001****	
1-7	61.4	38.6			1 (reference)
8-50	39.1	60.9			2.477 (1.585, 3.869)
Smoking duration (years)			3.311	0.069	
0.50-2.50	56.0	44.0			1 (reference)
2.67-20	46.0	54.0			1.498 (0.969, 2.316)
Smoking (Times)			41.188	**<0.001****	
1-4	65.5	34.5			1 (reference)
5-20	29.2	70.8			4.593 (2.846, 7.413)
Smoking duration (minutes)			73.216	**<0.001****	
1-10	70.4	29.6			1 (reference)
12-120	22.1	77.9			8.369 (5.005, 13.992)

****Means Pearson's Chi-square test and significant at p-value 0.01**

c. Associations of Socio-demographic characteristics and exposure factors towards cancer risk of cadmium

The results of the Chi-square test showed a significant association of 4 variables from weight, number of cigarette smoking per day, smoking times, and smoking duration (minutes). From the weight result, compared to participants with lower weight, those with higher weight are 45.4% less likely to have higher risk of cancer risk of cadmium. (OR = 0.546, 95% CI = 0.352, 0.847). For cigarette amount, compared to participants with smoking of 1-7 cigarettes per day, participants with smoking of 8-50 cigarettes per day are 2.547 times more likely to have higher risk of cancer risk of cadmium (p value < 0.001, OR = 2.547, 95% CI = 1.629, 3.981).

For smoking times, compared to participants with 1-4 times smoke cigarette a day, participants with 5-20 times smoke cigarette a day are 4.491 times more likely to have higher risk of cancer risk of cadmium (p value < 0.001, OR = 4.491, 95% CI = 2.785, 7.244). In addition, for smoking duration (minutes) compared to participants with 1-10 minutes smoke cigarette, participants with 12-120 minutes smoke cigarette are 8.167 times more likely to have higher risk of cancer risk of cadmium (p value < 0.01, OR = 8.167, 95% CI = 4.889, 13.643).

Table 16 cancer risk of cadmium

Independent Variables	Cancer risk of cadmium				
	≤ Median (%)	> Median (%)	*X*2	*p-Value*	OR (95% of CI)
Age (Years)			0.724	0.395	
20-23	48.6	51.4			1 (reference)
24-35	53.3	46.7			0.828 (0.536, 1.279)
Weight (kg)			7.349	**0.007****	
34-60	43.3	56.7			1 (reference)
61-128	58.3	41.7			0.546 (0.352, 0.847)
Height (cm)			2.201	0.138	
150-169	54.7	45.3			1 (reference)
170-189	46.5	53.5			1.390 (0.899, 2.148)
Education			0.513	0.474	
Lower than High School	48.8	51.2			1 (reference)
Bachelor and higher	52.7	47.3			0.853 (0.553, 1.317)
Occupation			0.027	0.869	
Government officer, Students, Merchant.	50.3	49.7			1 (reference)
Private officer, Labor, Entrepreneur, Others.	51.2	48.8			0.964 (0.625, 1.487)
Diseases			1.127	0.288	
No disease	49.8	50.2			1 (reference)
Have disease	60.0	40.0			0.662 (0.308, 1.423)
Cigarette per day (number)			17.131	**<0.001****	
1-7	61.4	38.6			1 (reference)
8-50	38.4	61.6			2.547 (1.629, 3.981)
Smoking duration (years)			2.926	0.087	
0.50-2.50	55.4	44.6			1 (reference)
2.67-20	46.0	54.0			1.462 (0.946, 2.260)
Smoking (Times)			41.188	**<0.001****	
1-4	65.0	35.0			1 (reference)
5-20	29.2	70.8			4.491 (2.785, 7.244)
Smoking duration (minutes)			71.661	**<0.001****	
1-10	69.9	30.1			1 (reference)

12-120	22.1	77.9		8.167	(4.889, 13.643)

****Means Pearson's Chi-square test and significant at p-value 0.01**

d. Associations of Socio-demographic characteristics and exposure factors towards cancer risk of lead

The results of the Chi-square test showed a significant association of 4 variables from weight, number of cigarette smoking per day, smoking times, and smoking duration (minutes). From the weight result, compared to participants with lower weight, those with higher weight are 45.4% less likely to have higher risk of cancer risk of lead. (OR = 0.546, 95% CI = 0.352, 0.847). For cigarette amount, compared to participants with smoking of 1-7 cigarettes per day, participants with smoking of 8-50 cigarettes per day are 2.547 times more likely to have higher risk of cancer risk of lead (p value < 0.001, OR = 2.547, 95% CI = 1.629, 3.981). For smoking times, compared to participants with 1-4 times smoke cigarette a day, participants with 5-20 times smoke cigarette a day are 4.491 times more likely to have higher risk of cancer risk of lead (p value < 0.001, OR = 4.491, 95% CI = 2.785, 7.244). In addition, for smoking duration (minutes) compared to participants with 1-10 minutes smoke cigarette, participants with 12-120 minutes smoke cigarette are 8.167 times more likely to have higher risk of cancer risk of lead (p value < 0.01, OR = 8.167, 95% CI = 4.889, 13.643) 8.167 (4.889, 13.643).

Table 17 cancer risk of lead

Independent Variables	Cancer risk of lead				
	≤ Median (%)	> Median (%)	*X*2	*p-Value*	OR (95% of CI)
Age (Years)			0.724	0.395	
20-23	48.6	51.4			1 (reference)
24-35	53.3	46.7			0.828 (0.536, 1.279)
Weight (kg)			7.349	**0.007****	
34-60	43.3	56.7			1 (reference)
61-128	58.3	41.7			0.546 (0.352, 0.847)
Height (cm)			2.201	0.138	
150-169	54.7	45.3			1 (reference)
170-189	46.5	53.5			1.390 (0.899, 2.148)
Education			0.513	0.474	
Lower than High School	48.8	51.2			1 (reference)
Bachelor and higher	52.7	47.3			1.853 (0.553, 1.317)

Occupation			0.27	0.869	
Government officer, Students, Merchant.	50.3	49.7			1 (reference)
Private officer, Labor, Entrepreneur, Others.	51.2	48.8			0.964 (0.625, 1.487)
Diseases			1.127	0.288	
No disease	49.8	50.2			1 (reference)
Have disease	60.0	40.0			0.662 (0.308, 1.423)
Cigarette per day (number)			17.131	**<0.001****	
1-7	61.4	38.6			1 (reference)
8-50	38.4	61.6			2.547 (1.629, 3.981)
Smoking duration (years)			2.926	0.087	
0.50-2.50	56.0	44.0			1 (reference)
2.67-20	46.0	54.0			1.462 (0.946, 2.260)
Smoking (Times)			40.034	**<0.001****	
1-4	65.0	35.0			1 (reference)
5-20	29.2	70.8			4.491 (2.785, 7.244)
Smoking duration (minutes)			71.661	**<0.001****	
1-10	69.9	30.1			1 (reference)
12-120	22.1	77.9			8.167 (4.889, 13.643)

****Means Pearson's Chi-square test and significant at p-value 0.01**

CHAPTER V
DISCUSSION

This chapter describes the discussion based discussion-based on the research findings of this study. This study was using primary data which were obtained from the respondents using an e-questionnaire to collect the data. The subject of of this study are Indonesian male smokers aged 20 – 35 years and there were 327 subjects in this study. This study was aimed (1) To assess the human health risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers. (2) To investigate the cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers, and (3) To investigate the non-cancer risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers. Moreover, this study investigated the association between socio-demographic, exposure factors, and health risk among Indonesian smokers. The results of this study are discussed by comparing with findings of other research worldwide.

5.1 Characteristics of respondents

Within the total 327 respondents, more than half (72.2%) of the total respondents in the study were age 20 - 25 years, the rest of the percentage were repondents who aged 26 - 35 (27.8%) which indicates that most of the respondent in the study had 20 - 25 years. The average weight and height of respondents were 60 kg and 170 cm, respectively. This is different from the research conducted by Erin (2017), which showed an average age of 32 years. And the age of the respondents in the study is lower than the research conducted by Jitnarin (2014) with the average 47 years with a body weight of 60 kilograms. Based on the provisions of the Ministry of Health, the older the respondent, the lower the smoking prevalence. From these results it can be said that the age of older adult smokers have started to realize the dangers of smoking, and started to stop smoking (Ministry of Health, 2013).

The two most dominated educational status in this study were bachelor degree (47.7%) and high school (41.3%) which means that the respondents it

can be said that they are educated and well-informed people. Meanwhile, in terms of employment status, private workers and students dominate with a percentage of (33.3) and (33.9), respectively, this may the reason for this result to get the average age in 23 years old because they spent more time to get the internet rather than those age 30 years older. In addition, respondents in this study did not have underlying diseases, but some were recorded to have congenital diseases such as: diabetes (5.5%), cardiovascular (1.5%), and others (2.1%). If seen from other research, Kimiko (2018) shows the same 2 dominant educational status, high school (53.7%) and university (35.5%). It is different in the research of Kamruzzaman (2022), which shows the status of labor work (45.6%) that dominates. It is thought that education has a profound effect on smoking initiation on the younger population, while occupation can affect smoking cessation of the middle-age and older population (Wang, 2018). Kim's research (2021), shows that as many as (94.64%) smokers do not have congenital diseases and as many as (5.36%) have congenital diseases which means they have similarities with this study.

The average cigarette consumption in Indonesian respondents is 8 cigarettes (13.8%) per day for 10 minutes (23.9%) in an average of one time smoke. On average, they smoked 4 times (19.3%) a day with an average of 3 years (9.5%) being active smokers. Other study shows higher yields in daily cigarette consumption, almost a half of the respondents in research of Sharma (2014) smoked more than 31 for average daily cigarette consumption. Research from Gupta (2019), shows similar results to cigarette consumption of 11-20 cigarettes (32.1%) cigarettes per day, but differs in the duration of smoking, which is more than 10 years in average (44.6%). If a cigarette is consumed in ten puffs of cigarette smoke, then within a year, smokers of 20 cigarettes (one pack) per day will experience 70,000 puffs of cigarette smoke. Some of the chemicals in cigarettes that are harmful to health are cumulative, one day the poison dose will reach the toxic point so that symptoms will begin to appear (Irawati et al., 2012).

Based on this study, from 327 respondents, it was found that 211 were smokers in the mild smoker category (64.5%), 85 respondents (26%) were

categorized as light smokers and as many as 31 respondents (9.5%) belonged to the category of a heavy smoker. Research conducted by Sreeramaredy (2014) that was conducting research about smoking prevalence in nine south and southeast asian country shows the highest prevalence was found in Indonesia (72.3%) that mostly smoked cigarettes. Other research conducted by Huijing (2020) in China, the higher proportion (44%) from the total sample 1748 shows cigarette consumption of more than 11 cigarettes that categorized as mild smoker. These findings in line with the statisctics Netherlands research (2019), In the Netherlands, people with lower education reported smoking the highest number of cigarettes that shows 12 cigarette each day which is classified as mild smoker.

5.2 Non-cancer risk of cadmium and lead

Based on the findings, the Hazard Index (HI) result of non-cancer of cadmium (Cd) and lead (Pb) which is the accumulated value from 2 heavy metals show higher than the standard value or 1 (HI > 1) (128.3) which means the respondents found non-cancer risk. Table 10 shows the estimated non-carcinogenic risks of metals that may be associated with direct inhalation exposure to cigarettes. The non-carcinogenic health risk associated with inhalation exposure posed by Cd and Pb 128.2 and 0.076, respectively. Notably, the potential non-carcinogenic risk estimated for Cd was generally higher than Pb. In this study, it was shown that the HI of Cd was extremely higher than that of Pb, it is indicating the highest potential for non-carcinogenic health risk of cadmium in cigarettes that may affect both for active smokers or passive smokers. This results also supported by Dinh et al., (2021) that shows the average HI values of Cd and Pb were 40.7, and 9.78, respectively. However, the hazard Quotient (HQ) result of Pb shows the acceptable level with the value less than 1. Therefore, it can be inferred that having HI estimates greater than 1.0 indicate that Cd and Pb concentrations could pose non-cancer health effects to the smokers through direct and long-term inhalation exposure. The result of HI is actually the same with the research of Benson (2017), that shows HI for Cd and Pb were greater than 1.0

(HI > 1), but in this study it was found that the HQ results showed both of them had more than 1. The high exposure to cadmium in cigarettes is also supported by research conducted by Mayaserli (2018), which shows levels of cadmium in the urine of smokers, which means that smokers are more at risk for exposure to non-cancer risks. Although the HQ value of Pb investigated in this studywas relatively lower than Cd, the smokers should also be concern due to the direct and long-term inhalation exposure.

The kidney appears to be the main target organ in humans following chronic inhalation exposure to cadmium. Abnormal kidney function, indicated by proteinuria and a decrease in glomerular filtration rate, and an increased frequency of kidney stone formation are some of the effects that have been observed. Respiratory effects, such as bronchitis and emphysema, have also been noted in humans chronically exposed to cadmium through inhalation. Oral exposure to cadmium in humans also results in effects on the kidney, with effects similar to those seen following inhalation exposure. In humans, dermal exposure to cadmium does not appear to cause allergic reactions (ATSDR, 1999a)

The lead target for non-cancer risk including neurobehavioral impairment, including IQ deficits, has been associated with blood lead levels of 50 to 70 µg/dL in children. Chronic exposure to lead in humans can also affect the blood. Anemia has been reported in adults at blood lead levels of 50 to 80 µg/dL and in children at blood lead levels of 40 to 70 µg/dL. Other effects from chronic lead exposure in humans include effects on blood pressure and kidney function, interference with vitamin D metabolism, and reproductive effects (ATSDR, 1999c).

5.3 Cancer risk of cadmium and lead

In this study, the Cancer Risk (CR) value found the average of CR for Cd (4.62 × 10-6) exceeded the tolerable risk limit. While, the average CR for Pb (1.83 x 10-11) was lower than the acceptable risk level (1 × 10-6). However, when we looked the TCR result showed the exceeded value which means that people may get the carcinogenic effect of cigarette smoking from cadmium

and lead exposure through inhalation. Table 11 shows the estimated carcinogenic risks of metals that may be associated with direct inhalation exposure to cigarettes. Other studies show the results of CR by Dinh et al., (2021) both Cd (7.32 x 10-4) and Pb (0.88 x 10-6) which are exceeded the normal value for cancer risk. Other studies also show the same results by Benson (2017) that the human cancer risks posed by Cd and Pb ranged between 1.87 x 10-2 and 2.52 x 10-2, 1.05 x 10-3 and 4.76 x 10-3, respectively. The cancer risk values for Cd and Pb for all cigarettes investigated were above the acceptable limit (1.00E-4) set by US EPA. Research from Edgar (2020) shows, The lung tissue of smokers that had a higher content of the heavy metals that were analyzed elements compared to the lung tissue of nonsmokers. It found that the significant higher levels of cadmium and lead were found in smoker's lung tissue. The lead, mean level was three times higher in smokers than nonsmokers (0.32 vs. 0.11 g/g). The cadmium level was almost ten times higher in the lung tissue of smokers compared to non-smokers (0.68 vs. 0.074 g/g). Thus, it is evident that smoking influences the content of cadmium and lead in the lung tissue. This results indicated that cadmium and lead is a heavy metals that can cause cancer such as lung cancer. Another result also supported the concentration that found in lung. Paakko et al that determined the Cd level in the lung tissue of 45 individuals and found that Cd was significantly higher in smokers than non-smokers (3.0 vs. 0.4 g/g). Cadmium have been classified in Group 1 (Carcinogenic to humans) and lead in Group 2A (probably carcinogenic) by IARC (2006). Thus, smokers have an increased risk of developing lung diseases due to exposure to these metals present in tobacco.

5.4 Associated Factors

To find the association of socio-demographic characteristics and exposure factors towards non-cancer risk and cancer risk of cadmium and lead, bivariate analysis of Chi-square test was performed. The significant variables in Chi-square test include socio-demographic characteristic of weight; and exposure

factors of number of cigarette smoking per day, smoking times, and smoking duration (minutes) in each dependent variables.

Associations of Socio-demographic characteristics of weight towards non-cancer risk and cancer risk of cadmium and lead: The analysis showed that the weight result, compared to participants with lower weight, those with higher weight are less likely to have higher risk. These findings are consistent with the research of Demetrius, (1987) that were using the data of NHANES to know the association between smoking and bodyweight of US population that did not found ex-smokers to be heavier or fatter than nonsmokers. The potential exists for tobacco use to strongly confound epidemiologic studies investigating the relation between absolute or relative body weight and cancer, as well as other diseases or causes of death. Evidence for such confounding is available from studies which assessed smoking status and demonstrated that leanness was a risk factor among cigarette smokers only. In their study of an American Cancer Society survey, Lew and Garfinkel showed that excess mortality from all causes (particularly smoking-related cancers) among those underweight was restricted to smokers.

There were some controversies about the associations between smoking and weight. The current studies from Carreras et al., (2017), obesity is a risk factors of chronic diseases, and smoking is associated with both chronic diseases and obesity. Obesity is also a major risk factor of many chronic diseases, such as cardiovascular diseases (CVD), hypertension, hyperlipidemia and certain types of cancer. Tobacco exposure and obesity are the only modifiable factors with convincing evidence to be considered causal risk factors for pancreatic cancer. A dose-response relationship has been observed with cigarette smoking Bosetti et al., (2011). Additionally, obesity is linked to a cascade of metabolic conditions, including hypercholesterolemia, hyperglycemia, insulin resistance, and type 2 diabetes. Cholesterol intake, higher glucose levels, hyperinsulinemia, and type 2 diabetes status have all been identified as potential pancreatic cancer risk factors (Elena, 2012). Asia Pacific Cohort Studies Collaboration (2009), the relationship between BMI

and risk of coronary heart disease is amplified by the effects of smoking, such that the excess risk for coronary heart disease associated with being overweight in smokers was more than double that of non-smokers.

Associations of exposure factors (number of cigarette smoking per day, smoking times, and smoking duration (minutes)) towards non-cancer risk and cancer risk of cadmium and lead: The analysis showed that people who were more using cigarette, more smoke times to smoke, and more duration in smoking are having more non-cancer and cancer risk due to the heavy metals included cadmium and lead. Smoking is a significant risk factor for cardiovascular diseases (CVDs) given that certain common pathologies, including hypertension, dyslipidemia and type 2 diabetes mellitus, are major risk factors for CVDs, the association of smoking with CVDs may be attributable, at least in part, to its effects on common diseases. Based on Maki et al., (2019) larger increases in consuming cigarette per day were associated with higher death risks than were smaller increases in cigarette per day consumption. The cigarette consumption is in line with the smoking duration and how many times they smoke cigarette. The more number of cigarettes, the duration of time when smoking, and the number of cigarettes in a day will greatly affect the health effects. In many previous studies, dose-dependent associations with cigarette consumption and lifetime exposure metric have been demonstrated with disease endpoints and mortality (US Department of Health and Human Services, 2014). the amount of smoke, and the length of time smoking for affect cancer risk. The more cigarettes smoke a day, the higher risk of cancer. But the number of years spend for smoking affects cancer risk most strongly (Cancer Research UK).

Other factors found from other research that cause cancer risk is alcohol consumption to estimate the combined effects of multiple risk factors. The risks of cancer incidence and death in individuals who were both active smokers and consumers of alcohol. Those who were consuming alcohol have the risks of esophageal cancer; liver cancer; and tracheal, bronchial, and lung cancers were 4.4-, 1.6-, and 2.3-times higher, respectively, than those in non-

consumers of alcohol. In addition, the risk factors for death from esophageal cancer and liver cancer were 6.1 and 2.2, respectively. All of these cancer risk may get worse when it combined with smoking cigarette consumption (Jung, 2022). Castellsagué et al. (1999) compared the combined and independent effects of smoking and alcohol consumption for esophageal cancer and reported odds ratios (ORs) of 1.95 and 1.75 for only smoking and only consuming alcohol, respectively. However, the OR for combined smoking and consuming alcohol was 8.0, indicating a synergistic interaction between these two risk factors. Keilman and colleagues used datasets from the World Health Organization and World Alcohol Project from 19 countries. Diabetes and cirrhosis mortality rates were associated with alcohol consumption only for men. Wine-drinking countries consumed the most alcohol and had the highest cirrhosis mortality rates. Beer-drinking countries had the highest beverage calories per capita and diabetes mortality rates (Keilman, 2011).

Another cause of cancer is air pollution, the International Agency for Research on Cancer (IARC) classified both outdoor air pollution and PM in outdoor air pollution as Group 1 human carcinogens for lung cancer (IARC, 2013). The IARC evaluation noted that general population cohort studies with quantitative data on long-term estimates of outdoor air pollution exposure, including the large-scale American Cancer Society (ACS) Cancer Prevention Study-II (CPS-II) and the European Study of Cohorts for Air Pollution Effects (ESCAPE), were particularly informative in their evaluation with a broad range of exposures considered and detailed information on potential confounders, notably cigarette smoking (Krewski, 2009). Because the possibility of residual confounding by cigarette smoking of reported air pollution effects had remained a concern, the analysis of thousands of never-smokers in the ACS CPS-II study, which observed increased lung cancer mortality associated with long-term $PM_{2.5}$ exposure, was particularly influential. Interestingly, the IARC conclusion of a causal link between outdoor air pollution and PM in outdoor air with increased lung cancer risk was long ago foreshadowed, given the presence of carcinogens in ambient air.

CHAPTER VI
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This study was aimed to assess the human health risk related to lead and cadmium exposure from cigarette smoking among Indonesian smokers. The findings of the study showed from the total respondents of 327 (100%) found the mean of age was 23.96, most of them are in the age group of 20-25 years, with a percentage of 72.2%, as many as 236 people. The results of their weight and height characteristics of the mean was 62.48 kg and 168.30 cm, respectively. Most of the respondents work indoors with a percentage of 59%. The two most common occupations of respondents were students (33.9%) and officers (33.3%) with education level of bachelor's degree with a percentage of 47.7%. A total of 297 respondents do not have congenital diseases.

The average daily smoking rate of tobacco cigarettes was 7.85 cigarettes/day. The average smoking duration was 3.18 years with the smoking frequency 4.47 times a day with more than half or 211 were smokers in the mild smoker category (64.5%). The respondents found a substantial non-cancer risk posed by heavy metals with the mean for Cd and Pb were 128.2 and 0.076, respectively, which means that the sum or Hazard Index result (HI >1) indicate all of the respondents found non-cancer risk. While the Cancer Risk inhalation posed by personal Cd exposure via inhalation was the highest among those 2 heavy metals. The average of CR for Cd (4.62×10^{-6}) exceeded the tolerable risk limit, while the average CR for Pb (1.83×10^{-11}) was lower than the acceptable risk level (1×10^{-6}). These results indicate ~ 5 out of one million adults living in the study area are possible to be cancer from inhaling cadmium and lead during their lifetime.

In order to know the associated factors between socio-demographic characteristics and exposure factors, bivariate analysis by chi-square test was used to find the associated variables of non-cancer risk of cadmium, and the OR was also calculated. Variables with a p-value < 0.05 were considered statistically significant. Finally, The results of the Chi-square test showed a

significant association of 4 independent variables from weight, number of cigarette smoking per day, smoking times, and smoking duration (minutes).

6.2 Limitations

- This study focused only on 2 heavy metals, namely Cd, and Pb in the Indonesian local cigarette, and other associated heavy metals were not investigated.
- Only the inhalation route was considered for the non-cancer and cancer risks assessment of the participants who exposed to the heavy metals in the tobacco cigarette.
- The average age was 23 years old in the range age of 20-35 years old, it was because most of the younger use the internet and social media more than people over 30 years old.

6.3 Recommendation

This study was aimed to assess the human health risk related from cigarette smoking among Indonesian smokers. The data will be useful for the local government, Ministry of Health, and other sectoral as it will enlighten challenges or barriers in addressing various health problem that caused by cigarette smoking.

6.3.1. Recommendation for personal level

- Decrease the amount of daily cigarette consumption up to 5 cigarettes per day for maximum consumption.
- Decrease the duration of cigarette consumption, not longer than 2 years should stop early.
- In the family environment, it is expected not to smoke according to the regulations issued by the Ministry of Health, family as the smallest group in society to be a role the main model and reference for non-smoking behavior for the surrounding environment by do not smoke.
- Ask for help or assistance from other parties in an effort to stop smoking.

- Divert smoking dependence on more positive things such as doing sports activities, adding insight about the dangers of smoking by reading.

6.3.2. Recommendation for community level

- Implementing government programs to succeed in reducing the number of tobacco consumption such as restrictions on cigarette advertising in various media, no smoke place by giving signs and punishment for those breaking the rules.
- Collaborate with primary health care in promoting smoking cessation programs by providing health education and health consultations in every event that involves many people in order to reach all community groups.

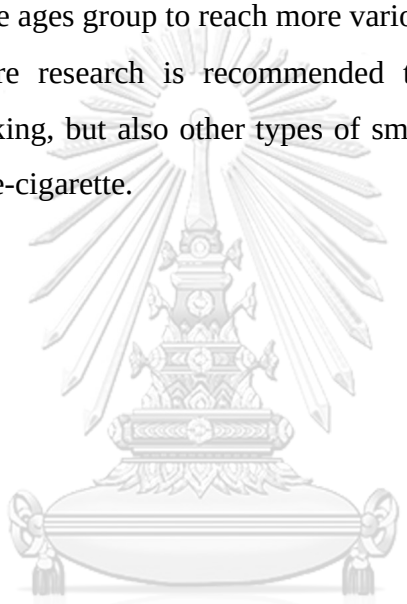
6.3.3. Recommendations for National level or Governments and Ministry of Health

Based on the findings of the study, the following recommendations are suggested:

- The Heavy Metals in a cigarettes are also a health concern issue, not only nicotine.
- The higher prevalence of cigarette consumption indicates that implementation and enforcement of the related laws or regulation should be prosecuted vigorously.
- Since society get most of the information from internet, Ministry of Health should use internet and social media engage with other stakeholders to deliver the education and information regarding quit smoking and the health effect of cigarette smoking massively.
- Moreover, the government should be established the quit smoking service for smokers to get the information if the smoker wants to quit.
- At the community level, safe environment place for society should be created by government massively. Especially for the public place should have strict regulation for not smoking symbols.

6.3.4. Recommendations for further research

- Further research studies should involve more wide areas from other cities in order to be more representative and reflect the country situation.
- It is recommend for future research to be more comprehensive to include the real heavy metals concentration in air of the smokers bu using a specific tools to measure it.
- Future cross-sectional research are recommended to include most of the ages group to reach more various ages of respondents.
- Future research is recommended to include not only cigarette smoking, but also other types of smoking such as Shisha, Baraku, and e-cigarette.



REFERENCES

[1] Blecher E. Cigarette affordability in Indonesia. A Tobacconomics Policy Brief, the University of Illinois at Chicago, 2018.

[2] Bosetti C, Lucenteforte E, Silverman DT et al. , *Cigarette smoking and pancreatic cancer: An analysis from the International Pancreatic Cancer Case-Control Consortium* (Panc4). *Ann Oncol.* 2012;23:280–284.

[3] Carreras-Torres, R. *et al*. 2017. The role of obesity, type 2 diabetes, and metabolic. factors in pancreatic cancer: a mendelian randomization Study. *J Natl Cancer Inst* **109**, 495.

[4] Castellsagué et al., 1999. *Independent and joint effects of tobacco smoking and alcohol drinking on the risk of esophageal cancer in men and women*.

[5] Center and Information. 2015. Bulletin of Health Data and Information Window. Indonesian Ministry of Health.

[6] Danusanto, H.1991. Cigarettes and Smokers. Jakarta: Aksara

[7] Davis and Svendsgaard, 1987 Davis, J.M., Svendsgaard, D.J., 1987. Lead and child development. Nature 329, 297-300; Goering, 1993; Schwartz, 1994.

[8] Dinh et al., 2021. Mercury, Cadmium, and Lead in Cigarettes from International Markets. Japan

[9] Effects. Leduc et al., 1993 Leduc, D., Francquen, P., Jacobovitz, D., Vandeweyer, R., Lauwerys, R., De Vuyst, P., 1993. Association of cadmium exposure with rapidly progressive emphysema in a smoker. Thorax 48, 570-571; Sorahan and Lancashire, 1997.

[10] Elena J.W et al., 2012. Diabetes and risk of pancreatic cancer: a pooled analysis from the pancreatic cancer cohort consortium.

[11] Erin et al., 2017. Characteristics of Cigarette Smoking in Individuals in Smoking Concordant and Smoking Discordant Couples.

[12] Galazyn-Sidorczuk, M.; Brzóska M.M.; Moniuszko-Jakoniuk, J. Estimation of Polish cigarettes contamination with cadmium and lead, and exposure to these metals via smoking. Environ. Monit. Assess. 2008, 137, 481–493.

[13] GBD 2015 Tobacco Collaborators. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990-2015: a systematic

analysis from the Global Burden of Disease Study 2015. *Lancet*. 2017;389 (10082):1885-1906.

[14] Global Data. Cigarettes in Indonesia, 2019.

[15] Goodchild M, Nargis N, Tursan d'Espaignet E. Global economic cost of smoking-attributable diseases. Tob Control.

[16] Government of Canada (2008, 28 November). Terminology. https://www.canada.ca/en/health-canada/services/health-concerns/tobacco/research/tobacco-use-statistics/terminology.html

[17] Hendrick, D. J. (2004) Thorax 59, 184 – 185

[18] Hossn E, Mokhtar G, El-Awady M, Ali I, Morsy M, Dawood A. Environmental exposure of the pediatric age groups in Cairo City and its suburbs to cadmium pollution. Sci Total Environ 2001; 273: 135–46.

[19] Huijing et al., 2020. *Smoking Prevalence, Patterns, and Cessation Among Adults in Hebei Province, Central China: Implications From China National Health Survey (CNHS).*

[20] IARC (1993). Summaries & evaluations: Cadmium and cadmium compounds (Group 1). Lyon, International Agency for Research on Cancer, p. 119 (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 58;

[21] IARC, Cadmium and cadmium Compounds, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, 58 (1993) 119–237.

[22] IARC, Cadmium and cadmium Compounds, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, 58 (1993) 119–237.

[23] Indonesian Minister of Health. 2013. Regulation of the Minister of Health of the Republic of Indonesia No. 23 of 2013 concerning the Inclusion of Health Warnings and Health Information on Tobacco Product Packaging.

[24] International Agency for Research on Cancer (IARC), Tobacco Smoking, IARC Monograph 38, International Agency of Research on Cancer, Lyon, France, 1986.

[25] International Agency for Research on Cancer (IARC). 2013. *Outdoor Air Pollution. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*. Vol 109.

[26] J. Fowles and E. Dybing, “Application of toxicological risk assessment principles to the chemical constituents of cigarette smoke,” Tobacco Control, vol. 12, no. 4, pp. 424–430, 2003

[27] Jarup L, Berglund M, Elinder CG, Nordberg G, Vahter M. Health effects of cadmium exposure—a review of the literature and a risk estimate. Scand J Work Environ Health 1998; 24 (Suppl 1): 1–51.

[28] Jarup, L. (2003) Br. Med. Bull. 68, 167 – 182).

[29] Jitnarin et al., 2011. The Relationship Between Smoking, Body Weight, Body Mass Index, and Dietary Intake Among Thai Adults: Results of the National Thai Food Consumption Survey.

[30] Jung et al., 2022. Burden of Cancer Due to Cigarette Smoking and Alcohol Consumption in Korea.

[31] Kamruzzaman et al., 2022. Smoker’s characteristics, general health and their perception of smoking in the social environment: a study of smokers in Rajshahi City, Bangladesh.

[32] Keilman PA. 2011. Alcohol consumption and diabetes mellitus mortality in different countries. Am J Public Health. 1983;73(11):1316–7.

[33] Kim, S et al., 2021. The Relationships between Smoking Cigarette and Metabolic Syndrome. Seoul.

[34] Kimiko et al., 2020. The Association Between Education and Smoking Prevalence, Independent of Occupation: A Nationally Representative Survey in Japan.

[35] Krewski D, Jerret M burnett RT, et al. 2009. *Extended Follow-up and Soatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality.* Health Effects Institute.

[36] Kuhnert, B. R., Kuhnert, P. M., Debanne, S., and Williams, T. G. (1987) Am. J. Obstet. Gynecol. 157, 1247 – 1251.

[37] Kwamanga DH, Odhiambo JA, Amukoye EI. Prevalence and risk factors of smoking among secondary school students in Nairobi. EastAfrMedJ.2003;80(4):207-12.

[38] Lew EA, Garfinkel L: Variations in mortality by weight among 750,000 men and women. J Chronic Dis 1979; 32:563-576. 3. Sorlie P, Gordon T, Kannel

WB: Body build and mortality: the Framingham study. JAMA 1980; 243:1828-1831.

[39] Lustberg M, Silbergeld E. Blood lead levels and mortality. Arch Intern Med. 2002;162:2443–2449.

[40] M. Galazyn-Sidorczuk, M. M. Brzoska, and J. Moniuszko- ´ Jakoniuk, "Estimation of Polish cigarettes contamination with cadmium and lead, and exposure to these metals via smoking," Environmental Monitoring and Assessment, vol. 137, no. 1–3, pp. 481–493, 2008.

[41] Marano, K.M.; Naufal, Z.S.; Kathman, S.J.; Bodnar, J.A.; Borgerding, M.F.; Wilson, C.L. Arsenic exposure and tobacco consumption: Biomarkers and risk assessment. Regul. Toxicol. Pharmacol. 2012, 64, 225–232.

[42] Mboi N, Murty Surbakti I, Trihandini I, Elyazar I, Houston Smith K, Bahjuri Ali P et al. On the road to universal health care in Indonesia, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet.

[43] Mavrikou, S.; Flampouri, K. Sensors. 2008, 8(4), 2818-2832.

[44] Mortada, W. I., Sobh, M. A., and El Defrawy, M. M. (2004) Med. Sci. Monit. 10, CR112 – CR116.

[45] Navas-Acien, A., Selvin, E., Sharrett, A. R., Calderon-Aranda, E., Silbergeld, E., and Guallar, E. (2004) Circulation 109, 3196 – 3201.

[46] Netherlands Health Survey / Lifestyle Monitor, Statistics (CBS) in collaboration with National Institute for Public Health and the Environment (RIVM), and Trimbos Institute, 2019.

[47] Nusa G.B., "Perbedaan Neutrophil-Lymphocyte Ratio Pada Subjek Bukan Perokok, Perokok Ringan Dan Perokok Sedang- Berat" (Universitas Diponegoro, 2016), h 9.

[48] Peltzer K. Smokeless tobacco and cigarette use among black secondary school students in South Africa. Subst Use Misuse. 2003;38(7):1003-16.

[49] Population 50 Lanphear BP, Rauch S, Auinger P, Allen RW, Hornung RW. Low-level lead exposure and mortality in US adults: a population-based cohort study. Lancet Public Heal. 2018;3:e177–e184,51.

[50] Preuss, H. G. (1993) J. Am. Coll. Nutr. 12, 246 – 254.

[51] Richter, P.A.; Bishop, E.E.; Wang, J.; Swahn, M.H. Tobacco smoke exposure and levels of urinary metals in the U.S. youth and adult population: the National Health and Nutrition Examination Survey (NHANES) 1999–2004. Int. J. Environ. Res. Public Health. 2009, 6, 1930–1946

[52] Riset Kesehatan Dasar (Riskesdas). Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan (LPB), Ministry of Health, Indonesia; 2018.

[53] Riskesdas. Report of National Basic Health Research 2018. Jakarta; 2018.

[54] Satarug, S., and Moore, M. R. (2004) Environ. Health Perspect. 112, 1099 – 1103). Mortada et al. (11 Mortada, W. I., Sobh, M. A., and El Defrawy, M. M. (2004) Med. Sci. Monit. 10, CR112 – CR116).

[55] Satarug, S., and Moore, M. R. (2004) Environ. Health Perspect. 112, 1099 – 1103

[56] Satarug, S., Ujjin, P., Vanavanitkun, Y., Nishijo, M., Baker, J. R., and Moore, M. R. (2004) Toxicology 204, 161 – 173.

[57] Seidal K, Jorgensen N, Elinder CG, Sjogren B, Vahter M. Fatal cadmium-induced pneumonitis. Scand J Work Environ Health1993; 19: 429–31.

[58] Serdar, M.A.; Akin, B.S.; Razi, C.; Akin, O.; Tokgoz, S.; Kenar, L.; Aykut, O. The correlation between smoking status of family members and concentrations of toxic trace elements in the hair of children. Biol. Trace Elem. Res. 2012, 148, 11–17.

[59] Sharma, A., Szatkowski, L. Characteristics of smokers who have never tried to quit: evidence from the British Opinions and Lifestyle Survey. *BMC Public Health* **14,** 346 (2014). https://doi.org/10.1186/1471-2458-14-346.

[60] Shipman, 1986 Shipman, D.L., 1986. Cadmium food poisoning in a Missouri school. J. Environ. Health 49, 89.

[61] Sitepoe M. The specificity of Indonesian cigarettes: the issue of PP no. 81 of 1999 concerning the safety of cigarettes for health. Jakarta: Grasindo Publishing; 2000.

[62] Smet B. Health Psychology. Jakarta: PT Grasindo; 1994. 8-9 p

[63] Sreeramareddy et al., 2014. *Smoking and smokeless tobacco use in nine South and Southeast Asian countries: prevalence estimates and social*

determinants from Demographic and Health Surveys. Population Health Metrics

[64] Substance Abuse and Mental Health Services Administration (SAMHSA) 2004 National Survey on Drug Use and Health. 2005.

[65] Sukardja, I. D. G. 2010. Clinical Oncology. Surabaya: Airlangga University Press.

[66] Supriyanto, W., 2014. Cancer Early Detection, Treatment and Cure, Yogyakarta: Parama Ilmu.

[67] Tso, T. C. Production, physiology, and biochemistry of tobacco plant.1990.

[68] Tellez-Plaza M, Navas-Acien A, Crainiceanu CM, Guallar E. Cadmium exposure and hypertension in the 1999–2004 National Health and Nutrition Examination Survey (NHANES). Environ Health Perspect. 2008;116:51–56.

[69] Tellez-Plaza M, Navas-Acien A, Crainiceanu CM, Sharrett AR, Guallar E. Cadmium and peripheral arterial disease: gender differences in the 1999–2004 US National Health and Nutrition Examination Survey. Am J Epidemiol. 2010;172:671–681,54.

[70] Tellez-Plaza M, Navas-Acien A, Menke A, Crainiceanu CM, Pastor-Barriuso R, Guallar E. Cadmium exposure and all-cause and cardiovascular mortality in the U.S. general population. Environ Health Perspect. 2012;120:1017–1022,53.

[71] The Tobacco Atlas. Indonesia Fact Sheet. Indonesia; 2018 (https://file .tobaccoatlas.org/wp-content/uploads/pdf/ Indonesia-country-facts-en.pdf, accessed 7 April 2020)

[72] U.S. EPA. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. U.S. Environmental Protection Agency, Washington, DC, EPA/630/R-03/003F, 2005.

[73] US Department of Health and Human Services. *The Health Consequences of Smoking - 50 Years of Progress: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014.

[74] Viana G. F. D. S., K. S. Garcia, and J. A. Menezes-Filho, "Assessment of carcinogenic heavy metal levels in Brazilian cigarettes," Environmental Monitoring and Assessment, vol. 181, no. 1–4, pp. 255–265, 2011.

[75] Wang Q, Shen JJ, Sotero M, Li CA, Hou Z. Income, occupation and education: Are they related to smoking behaviors in China? *PLoS One*. 2018;13:e0192571.

[76] Warren CW, Riley L, Asma S et al. Tobacco use by youth: a surveillance report from the Global Youth Tobacco Survey project. Bull World Health Organ. 2000;78 (7) : 868-76.

[77] WHO, "WHO Report on the Global Tobacco Epidemic, 2008," WHO, Geneva, Switzerland, 2008, http://www.who.int/tobacco/mpower/mpower report full 2008.pdf

[78] WHO, "WHO Report on the Global Tobacco Epidemic, 2011," WHO, Geneva, Switzerland, 2011, http://www.who.int/tobacco/global report/2011

[79] World Bank. Aiming high: Indonesia's ambition to reduce stunting. Washington, DC: World Bank Group; 2018 (http://documents.worldbank.org/curated/en/913341 532704260864/pdf/128954-REVISED-WB-Nutrition-BookAiming-High-11-Sep 2018)

[80] World Health Organization Regional Office for South-East Asia. Indonesia factsheet 2018.

[81] World Health Organization Regional Office or South-East Asia. Indonesia factsheet 2018 (https://apps.who.int/iris/bitstream/handle/10665/272673 /wntd_2018_indonesia _fs.pdf, accessed 7 April 2020)

[82] World Health Organization. WHO Report on the Global Tobacco Epidemic 2019. Geneva: WHO, 2019.

[83] Yamane, Taro. 1967. Statistics, An Introductory Analysis, 2nd Ed., New York: Harper and Row.

[84] Yang JJ, Yu D, Wen W, et al. Tobacco smoking and mortality in Asia: a pooled meta-analysis. *JAMA Netw Open*. 2019.

[85] Zwar et al., 2012. “Smoking cessation guidelines for Australian general practice”. Australia.

APPENDIX

APPENDIX A: QUESTIONNAIRE

SCREENING QUESTIONNAIRE

The question will follow inclusion and exclusion criteria.

Do you smoke?

☐ Yes ☐ No (end screening questionnaire)

Age 20-35?

☐ Yes ☐ No (end screening questionnaire)

Do you live in Surakarta?

☐ Yes ☐ No (end screening questionnaire)

Do you have cancer?

☐ Yes ☐ No (end screening questionnaire)

ID: ……

Questionnaire

This questionnaire is a part of Thesis research at the College of Public Health Science, Chulalongkorn University. The title of this study is "**Health Risk Assessment Related to Cadmium and Lead Exposure from Cigarette Smoking among Indonesian Smokers in Surakarta: A Cross-Sectional Study**". This research is a part of the Master of Public Health program, of Mr.Panji Mukti. The purpose of this study is to assess the human health risk related to heavy metals exposure from cigarette smoking among Indonesian smokers. This questionnaire consists of as follow questions related to your personal information: Socio-demographic and smoking bahavior. All your answers and your information herein will be kept confidently and be used for academic purposes in this study only. Thank you for your cooperation.

1. Age ……. (Years Old)
2. Gender

   ☐ Male ☐ Female

3. Educational Status

   ☐ Lower than Primary High School ☐ Bachelor

   ☐ Primary High School ☐ Higher than bachelor

   ☐ High School
4. Body weight …….. (kg)
5. Height……. (cm)
6. Occupation

   ☐ Government officer ☐ Labor

   ☐ Student ☐ Entrepreneur

   ☐ Merchant ☐ Other ……..

   ☐ Officer
7. Working Place

   ☐ Indoor ☐ Outdoor
8. Do you have diseases

   ☐ None ☐ Cardiovascular disease

   ☐ Cancer ☐ Other ……..

   ☐ Diabetes
9. How long have you been smoking……month.
10. How long do you smoke per time …….. minutes…….hours.
11. How many time you smoke per day …….. times.
12. How many cigarette you smoke per day…….. cigarettes.

APPENDIX B: QUESTIONNAIRE (INDONESIA)

SCREENING QUESTIONNAIRE

Pertanyaan akan mengikuti kriteria inklusi dan eksklusi.

Apakah anda merokok?

☐ Ya ☐ Tidak (akhiri screening questionnaire)

Berusia 20-35 tahun?

☐ Ya ☐ Tidak (akhiri screening questionnaire)

Apakah anda tinggal di Surakarta?

☐ Ya ☐ Tidak (akhiri screening questionnaire)

Apakah anda menderita kanker?

☐ Ya ☐ Tidak (akhiri screening questionnaire)

KUESIONER

ID: ……

Kuesioner ini merupakan bagian dari penelitian tesis di Fakultas Ilmu Kesehatan Masyarakat, Universitas Chulalongkorn. Judul penelitian ini adalah "**Health Risk Assessment Related to Cadmium and Lead Exposure from Cigarette Smoking among Indonesian Smokers in Surakarta: A Cross-Sectional Study**". Penelitian ini merupakan bagian dari program Magister Kesehatan Masyarakat, Panji Mukti. Tujuan dari penelitian ini adalah untuk menilai risiko kesehatan manusia yang terkait dengan paparan logam berat dari merokok di kalangan perokok Indonesia. Kuesioner ini terdiri dari pertanyaan-pertanyaan berikut yang terkait dengan informasi pribadi Anda: sosio-demografis dan perilaku merokok. Semua jawaban dan informasi Anda di sini akan dijaga kerahasiaannya dan hanya digunakan untuk kepentingan akademis dalam penelitian ini. Terima kasih atas kerja sama anda.

13. Berapa usia anda? ……. (tahun)

14. Jenis kelamin

☐ Laki-laki ☐ Perempuan

15. Status Pendidikan

☐ Lebih rendah dari Sekolah Menengah Pertama ☐ Sarjana

☐ Sekolah Menengah Pertama ☐ Lebih tinggi dari Sarjana

☐ Sekolah Menengah Atas

16. Berat badan ……. (kg)
17. Tinggi badan ……. (cm)
18. Pekerjaan

☐ PNS ☐ Buruh

☐ Siswa/Mahasiswa ☐ Pengusaha

☐ Pedagang ☐ Lainnya ……..

☐ Karyawan swasta

19. Tempat bekerja

☐ Di dalam ruangan ☐ Di luar ruangan

20. Apakah anda memiliki penyakit?

☐ Tidak ada ☐ Penyakit kardiovaskular

☐ Kanker ☐ Lainnya ……

☐ Diabetes

21. Sudah berapa lama anda merokok? …….. bulan.
22. Berapa lama dalam sekali merokok? ……. menit …….. jam.
23. Berapa kali Anda merokok dalam sehari? …….. kali.
24. Berapa banyak rokok yang Anda hisap per hari, rata-rata? …….. rokok.

APPENDIX C: RESEARCH ETHIC

UNIVERSITAS MUHAMMADIYAH JAKARTA

FAKULTAS KEDOKTERAN DAN KESEHATAN

KETERANGAN LAYAK ETIK
DESCRIPTION OF ETHICAL EXEMPTION
"ETHICAL EXEMPTION"

No.070/PE/KE/FKK-UMJ/IV/2022

Protokol penelitian yang diusulkan oleh :
The research protocol proposed by

Peneliti utama : Panji Putra Bagus Karya Mukti S.Kep
Principal In Investigator

Nama Institusi : Chulalongkorn University
Name of the Institution

Dengan judul:
Title

"Penilaian Risiko Kesehatan Terkait Paparan Kadmium dan Lead dari Merokok pada Perokok Indonesia di Surakarta, Indonesia: Studi Cross-Sectional"

"Health Risk Assessment Related to Cadmium and Lead Exposure from Cigarette Smoking among Indonesian Smokers in Surakarta, Indonesia: A Cross-Sectional Study"

Dinyatakan layak etik sesuai 7 (tujuh) Standar WHO 2011, yaitu 1) Nilai Sosial, 2) Nilai Ilmiah, 3) Pemerataan Beban dan Manfaat, 4) Risiko, 5) Bujukan/Eksploitasi, 6) Kerahasiaan dan Privacy, dan 7) Persetujuan Setelah Penjelasan, yang merujuk pada Pedoman CIOMS 2016. Hal ini seperti yang ditunjukkan oleh terpenuhinya indikator setiap standar.

Declared to be ethically appropriate in accordance to 7 (seven) WHO 2011 Standards, 1) Social Values, 2) Scientific Values, 3) Equitable Assessment and Benefits, 4) Risks, 5) Persuasion/Exploitation, 6) Confidentiality and Privacy, and 7) Informed Concent, referring to the 2016 CIOMS Guidelines. This is as indicated by the fulfillment of the indicators of each standard.

Pernyataan Laik Etik ini berlaku selama kurun waktu tanggal 14 April 2022 sampai dengan tanggal 14 April 2023.

This declaration of ethics applies during the period April 14, 2022 until April 14, 2023.

April 14, 2022
Professor and Chairperson,

Dr. dr. Rahmini Shabariah, Sp.A

Program Studi : **Kampus A** • Kedokteran (S1) • Profesi Dokter
Jl. KH. Ahmad Dahlan, Cirendeu, Ciputat Timur - Tangerang Selatan
Banten Kode Pos 15419, Telp : 749-2135 Fax : 749-2168

Kampus B • Kedokteran (S1) • Profesi Dokter • Profesi Bidan
• Sarjana Gizi (S1) • Diploma III Kebidanan (DIII)
Jl. Cempaka Putih Tengah XXVII, No. 46, Jakarta, Telp/Fax : 424-0857
Jl. Cempaka Putih Tengah 1/1, Jakarta, Telp/Fax : 421-6417

APPENDIX D: RESEARCH ETHIC

FORMULIR PERSETUJUAN UNTUK BERPARTISIPASI DALAM PENELITIAN
(*INFORMED CONSENT/IC)*

Saya yang bertandatangan dibawah ini:

Nama :
Usia :
Jenis Kelamin :
Pekerjaan :
Alamat :

Dengan ini saya menyatakan bahwa saya *(SETUJU / TIDAK SETUJU) terlibat dalam penelitian yang berjudul (**Penilaian Risiko Kesehatan Terkait Paparan Kadmium dan Lead dari Merokok pada Perokok Indonesia di Surakarta, Indonesia: Studi Cross-Sectional**), dan telah mendapatkan penjelasan rinci tentang penelitian seperti berikut ini:

Penelitian ini bertujuan untuk menilai risiko kesehatan manusia yang terkait dengan paparan timbal dan kadmium dari merokok di kalangan perokok Indonesia. Subjek hanya perlu mengisi pertanyaan yang akan memakan waktu sekitar 10-15 menit yang dapat digunakan sebagai sumber pengetahuan menganai efek paparan logam berat yang terkandung dalam rokok dalam kontribusinya untuk berisiko kanker dan non-kanker. Penelitian ini tidak memiliki prosedur risiko yang dapat menyebabkan efek buruk pada fisik, mental, dan sosial peserta. Peserta dalam penelitian ini bersifat sukarela dan Anda dapat mengundurkan diri dari penelitian ini kapan saja. Jika Anda memiliki pertanyaan lebih lanjut atau untuk mendapatkan informasi lebih lanjut, peneliti dapat dihubungi setiap saat. Terima kasih atas kerja sama anda.

Pernyataan ini saya buat dengan sebenar-benarnya dan tanpa ada paksaan dari pihak manapun.

Surakarta,
…….2022
Tanda Tangan
(_____)

PENELITI:

Saya telah menjelaskan penelitian kepada partisipan yang bertandatangan diatas, dan saya
yakin bahwa partisipan tersebut paham tentang tujuan, proses, dan efek yang mungkin terjadi jika dia ikut terlibat dalam penelitian ini.

Surakarta,
…….2022
Tanda Tangan Peneliti
(_____)

APPENDIX E: RESEARCH TIMELINE

Table 9 Research Timeline

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Literature review											
Proposal developing											
Proposal exam											
Research ethic											
Data collection											
Data analysis											
Thesis writing											
Conference & final exam											

APPENDIX E: RESEARCH BUDGETS

Table 10 Research Budgets

No	Activity	Unit cost	Amount
1	Publication fee	7000	7000 baht
2	Research assistants	1000	1000 baht
3	Research Ethics Fee	2000	2000 baht
	Total		**10,000 baht**

APPENDIX F: CHI-SQUARE

1. AGE_NCCD

Crosstab

			NCCd_coded		Total
			1	2	
Age_coded	1	Count	85	90	175
		Expected Count	88.8	86.2	175.0
		% within Age_coded	48.6%	51.4%	100.0%
	2	Count	81	71	152
		Expected Count	77.2	74.8	152.0
		% within Age_coded	53.3%	46.7%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Age_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.724[a]	1	.395		
Continuity Correction[b]	.548	1	.459		
Likelihood Ratio	.725	1	.395		
Fisher's Exact Test				.438	.230
Linear-by-Linear Association	.722	1	.395		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 74.84.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age_coded (1 / 2)	.828	.536	1.279
For cohort NCCd_coded = 1	.911	.737	1.128
For cohort NCCd_coded = 2	1.101	.881	1.376
N of Valid Cases	327		

2. AGE_NCPB

Crosstab

			NCPb_coded		Total
			1	2	
Age_coded	1	Count	86	89	175
		Expected Count	89.4	85.6	175.0
		% within Age_coded	49.1%	50.9%	100.0%
	2	Count	81	71	152
		Expected Count	77.6	74.4	152.0
		% within Age_coded	53.3%	46.7%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within Age_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.560[a]	1	.454		
Continuity Correction[b]	.406	1	.524		
Likelihood Ratio	.560	1	.454		
Fisher's Exact Test				.506	.262
Linear-by-Linear Association	.558	1	.455		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 74.37.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age_coded (1 / 2)	.847	.548	1.309
For cohort NCPb_coded = 1	.922	.746	1.140
For cohort NCPb_coded = 2	1.089	.871	1.362
N of Valid Cases	327		

3. AGE_CCD

Crosstab

			CCd_coded		Total
			1	2	
Age_coded	1	Count	85	90	175
		Expected Count	88.8	86.2	175.0
		% within Age_coded	48.6%	51.4%	100.0%
	2	Count	81	71	152
		Expected Count	77.2	74.8	152.0
		% within Age_coded	53.3%	46.7%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Age_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.724[a]	1	.395		
Continuity Correction[b]	.548	1	.459		
Likelihood Ratio	.725	1	.395		
Fisher's Exact Test				.438	.230
Linear-by-Linear Association	.722	1	.395		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 74.84.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age_coded (1 / 2)	.828	.536	1.279
For cohort CCd_coded = 1	.911	.737	1.128
For cohort CCd_coded = 2	1.101	.881	1.376
N of Valid Cases	327		

4. AGE_CPB

Crosstab

			CPb_coded		Total
			1	2	
Age_coded	1	Count	85	90	175
		Expected Count	88.8	86.2	175.0
		% within Age_coded	48.6%	51.4%	100.0%
	2	Count	81	71	152
		Expected Count	77.2	74.8	152.0
		% within Age_coded	53.3%	46.7%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Age_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.724[a]	1	.395		
Continuity Correction[b]	.548	1	.459		
Likelihood Ratio	.725	1	.395		
Fisher's Exact Test				.438	.230
Linear-by-Linear Association	.722	1	.395		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 74.84.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age_coded (1 / 2)	.828	.536	1.279
For cohort CPb_coded = 1	.911	.737	1.128
For cohort CPb_coded = 2	1.101	.881	1.376
N of Valid Cases	327		

5. WEIGHT_NCCD

Crosstab

			NCCd_coded		
			1	2	Total
Weight_coded	1	Count	71	93	164
		Expected Count	83.3	80.7	164.0
		% within Weight_coded	43.3%	56.7%	100.0%
	2	Count	95	68	163
		Expected Count	82.7	80.3	163.0
		% within Weight_coded	58.3%	41.7%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Weight_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.349[a]	1	.007		
Continuity Correction[b]	6.761	1	.009		
Likelihood Ratio	7.377	1	.007		
Fisher's Exact Test				.008	.005
Linear-by-Linear Association	7.326	1	.007		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 80.25.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Weight_coded (1 / 2)	.546	.352	.847
For cohort NCCd_coded = 1	.743	.597	.924
For cohort NCCd_coded = 2	1.359	1.085	1.703
N of Valid Cases	327		

6. WEIGHT_NCPB

Crosstab

			NCPb_coded		Total
			1	2	
Weight_coded	1	Count	71	93	164
		Expected Count	83.8	80.2	164.0
		% within Weight_coded	43.3%	56.7%	100.0%
	2	Count	96	67	163
		Expected Count	83.2	79.8	163.0
		% within Weight_coded	58.9%	41.1%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within Weight_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.965[a]	1	.005		
Continuity Correction[b]	7.352	1	.007		
Likelihood Ratio	7.997	1	.005		
Fisher's Exact Test				.006	.003
Linear-by-Linear Association	7.940	1	.005		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.76.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Weight_coded (1 / 2)	.533	.343	.827
For cohort NCPb_coded = 1	.735	.592	.913
For cohort NCPb_coded = 2	1.380	1.099	1.732
N of Valid Cases	327		

7. WEIGHT_CCD

Crosstab

			CCd_coded		Total
			1	2	
Weight_coded	1	Count	71	93	164
		Expected Count	83.3	80.7	164.0
		% within Weight_coded	43.3%	56.7%	100.0%
	2	Count	95	68	163
		Expected Count	82.7	80.3	163.0
		% within Weight_coded	58.3%	41.7%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Weight_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.349[a]	1	.007		
Continuity Correction[b]	6.761	1	.009		
Likelihood Ratio	7.377	1	.007		
Fisher's Exact Test				.008	.005
Linear-by-Linear Association	7.326	1	.007		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 80.25.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Weight_coded (1 / 2)	.546	.352	.847
For cohort CCd_coded = 1	.743	.597	.924
For cohort CCd_coded = 2	1.359	1.085	1.703
N of Valid Cases	327		

8. WEIGHT_CPB

Crosstab

			CPb_coded		Total
			1	2	
Weight_coded	1	Count	71	93	164
		Expected Count	83.3	80.7	164.0
		% within Weight_coded	43.3%	56.7%	100.0%
	2	Count	95	68	163
		Expected Count	82.7	80.3	163.0
		% within Weight_coded	58.3%	41.7%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Weight_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.349[a]	1	.007		
Continuity Correction[b]	6.761	1	.009		
Likelihood Ratio	7.377	1	.007		
Fisher's Exact Test				.008	.005
Linear-by-Linear Association	7.326	1	.007		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 80.25.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Weight_coded (1 / 2)	.546	.352	.847
For cohort CPb_coded = 1	.743	.597	.924
For cohort CPb_coded = 2	1.359	1.085	1.703
N of Valid Cases	327		

9. HEIGHT_NCCD

Crosstab

			NCCd_coded		Total
			1	2	
Hieght_coded	1	Count	93	77	170
		Expected Count	86.3	83.7	170.0
		% within Hieght_coded	54.7%	45.3%	100.0%
	2	Count	73	84	157
		Expected Count	79.7	77.3	157.0
		% within Hieght_coded	46.5%	53.5%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Hieght_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.201[a]	1	.138		
Continuity Correction[b]	1.884	1	.170		
Likelihood Ratio	2.203	1	.138		
Fisher's Exact Test				.151	.085
Linear-by-Linear Association	2.194	1	.139		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 77.30.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Hieght_coded (1 / 2)	1.390	.899	2.148
For cohort NCCd_coded = 1	1.177	.948	1.461
For cohort NCCd_coded = 2	.847	.679	1.055
N of Valid Cases	327		

10. HEIGHT_NCPB

Crosstab

			NCPb_coded		Total
			1	2	
Hieght_coded	1	Count	92	78	170
		Expected Count	86.8	83.2	170.0
		% within Hieght_coded	54.1%	45.9%	100.0%
	2	Count	75	82	157
		Expected Count	80.2	76.8	157.0
		% within Hieght_coded	47.8%	52.2%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within Hieght_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.316[a]	1	.251		
Continuity Correction[b]	1.074	1	.300		
Likelihood Ratio	1.317	1	.251		
Fisher's Exact Test				.269	.150
Linear-by-Linear Association	1.312	1	.252		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 76.82.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Hieght_coded (1 / 2)	1.290	.835	1.992
For cohort NCPb_coded = 1	1.133	.914	1.404
For cohort NCPb_coded = 2	.878	.704	1.096
N of Valid Cases	327		

11. HEIGHT_CCD

Crosstab

			CCd_coded		Total
			1	2	
Hieght_coded	1	Count	93	77	170
		Expected Count	86.3	83.7	170.0
		% within Hieght_coded	54.7%	45.3%	100.0%
	2	Count	73	84	157
		Expected Count	79.7	77.3	157.0
		% within Hieght_coded	46.5%	53.5%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Hieght_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.201[a]	1	.138		
Continuity Correction[b]	1.884	1	.170		
Likelihood Ratio	2.203	1	.138		
Fisher's Exact Test				.151	.085
Linear-by-Linear Association	2.194	1	.139		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 77.30.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Hieght_coded (1 / 2)	1.390	.899	2.148
For cohort CCd_coded = 1	1.177	.948	1.461
For cohort CCd_coded = 2	.847	.679	1.055
N of Valid Cases	327		

12. HEIGHT_CPB

Crosstab

			CPb_coded		Total
			1	2	
Hieght_coded	1	Count	93	77	170
		Expected Count	86.3	83.7	170.0
		% within Hieght_coded	54.7%	45.3%	100.0%
	2	Count	73	84	157
		Expected Count	79.7	77.3	157.0
		% within Hieght_coded	46.5%	53.5%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Hieght_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.201[a]	1	.138		
Continuity Correction[b]	1.884	1	.170		
Likelihood Ratio	2.203	1	.138		
Fisher's Exact Test				.151	.085
Linear-by-Linear Association	2.194	1	.139		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 77.30.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Hieght_coded (1 / 2)	1.390	.899	2.148
For cohort CPb_coded = 1	1.177	.948	1.461
For cohort CPb_coded = 2	.847	.679	1.055
N of Valid Cases	327		

13. EDUCATION_NCCD

Crosstab

			NCCd_coded		
			1	2	Total
Education_coded	1	Count	79	83	162
		Expected Count	82.2	79.8	162.0
		% within Education_coded	48.8%	51.2%	100.0%
	2	Count	87	78	165
		Expected Count	83.8	81.2	165.0
		% within Education_coded	52.7%	47.3%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Education_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.513[a]	1	.474		
Continuity Correction[b]	.367	1	.545		
Likelihood Ratio	.513	1	.474		
Fisher's Exact Test				.508	.272
Linear-by-Linear Association	.512	1	.474		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.76.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Education_coded (1 / 2)	.853	.553	1.317
For cohort NCCd_coded = 1	.925	.747	1.146
For cohort NCCd_coded = 2	1.084	.870	1.351
N of Valid Cases	327		

14. EDUCATION _NCPB

Crosstab

			NCPb_coded		
			1	2	Total
Education_coded	1	Count	79	83	162
		Expected Count	82.7	79.3	162.0
		% within Education_coded	48.8%	51.2%	100.0%
	2	Count	88	77	165
		Expected Count	84.3	80.7	165.0
		% within Education_coded	53.3%	46.7%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within Education_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.683[a]	1	.409		
Continuity Correction[b]	.512	1	.474		
Likelihood Ratio	.683	1	.409		
Fisher's Exact Test				.440	.237
Linear-by-Linear Association	.680	1	.409		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.27.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Education_coded (1 / 2)	.833	.540	1.286
For cohort NCPb_coded = 1	.914	.739	1.131
For cohort NCPb_coded = 2	1.098	.880	1.370
N of Valid Cases	327		

15. EDUCATION _CCD

Crosstab

			CCd_coded		Total
			1	2	
Education_coded	1	Count	79	83	162
		Expected Count	82.2	79.8	162.0
		% within Education_coded	48.8%	51.2%	100.0%
	2	Count	87	78	165
		Expected Count	83.8	81.2	165.0
		% within Education_coded	52.7%	47.3%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Education_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.513[a]	1	.474		
Continuity Correction[b]	.367	1	.545		
Likelihood Ratio	.513	1	.474		
Fisher's Exact Test				.508	.272
Linear-by-Linear Association	.512	1	.474		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.76.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Education_coded (1 / 2)	.853	.553	1.317
For cohort CCd_coded = 1	.925	.747	1.146
For cohort CCd_coded = 2	1.084	.870	1.351
N of Valid Cases	327		

16. EDUCATION _CPB

Crosstab

			CPb_coded		
			1	2	Total
Education_coded	1	Count	79	83	162
		Expected Count	82.2	79.8	162.0
		% within Education_coded	48.8%	51.2%	100.0%
	2	Count	87	78	165
		Expected Count	83.8	81.2	165.0
		% within Education_coded	52.7%	47.3%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Education_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.513[a]	1	.474		
Continuity Correction[b]	.367	1	.545		
Likelihood Ratio	.513	1	.474		
Fisher's Exact Test				.508	.272
Linear-by-Linear Association	.512	1	.474		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.76.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Education_coded (1 / 2)	.853	.553	1.317
For cohort CPb_coded = 1	.925	.747	1.146
For cohort CPb_coded = 2	1.084	.870	1.351
N of Valid Cases	327		

17. OCCUPATION_NCCD

Crosstab

			NCCd_coded		
			1	2	Total
Occupation_coded	1	Count	82	81	163
		Expected Count	82.7	80.3	163.0
		% within Occupation_coded	50.3%	49.7%	100.0%
	2	Count	84	80	164
		Expected Count	83.3	80.7	164.0
		% within Occupation_coded	51.2%	48.8%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Occupation_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.027[a]	1	.869		
Continuity Correction[b]	.003	1	.957		
Likelihood Ratio	.027	1	.869		
Fisher's Exact Test				.912	.478
Linear-by-Linear Association	.027	1	.869		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 80.25.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Occupation_coded (1 / 2)	.964	.625	1.487
For cohort NCCd_coded = 1	.982	.793	1.216
For cohort NCCd_coded = 2	1.019	.817	1.270
N of Valid Cases	327		

18. OCCUPATION _NCPB

Crosstab

			NCPb_coded		
			1	2	Total
Occupation_coded	1	Count	84	79	163
		Expected Count	83.2	79.8	163.0
		% within Occupation_coded	51.5%	48.5%	100.0%
	2	Count	83	81	164
		Expected Count	83.8	80.2	164.0
		% within Occupation_coded	50.6%	49.4%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within Occupation_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.028[a]	1	.867		
Continuity Correction[b]	.003	1	.955		
Likelihood Ratio	.028	1	.867		
Fisher's Exact Test				.912	.477
Linear-by-Linear Association	.028	1	.867		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.76.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Occupation_coded (1 / 2)	1.038	.673	1.601
For cohort NCPb_coded = 1	1.018	.824	1.259
For cohort NCPb_coded = 2	.981	.786	1.225
N of Valid Cases	327		

19. OCCUPATION _CCD

Crosstab

			CCd_coded		Total
			1	2	
Occupation_coded	1	Count	82	81	163
		Expected Count	82.7	80.3	163.0
		% within Occupation_coded	50.3%	49.7%	100.0%
	2	Count	84	80	164
		Expected Count	83.3	80.7	164.0
		% within Occupation_coded	51.2%	48.8%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Occupation_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.027[a]	1	.869		
Continuity Correction[b]	.003	1	.957		
Likelihood Ratio	.027	1	.869		
Fisher's Exact Test				.912	.478
Linear-by-Linear Association	.027	1	.869		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 80.25.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Occupation_coded (1 / 2)	.964	.625	1.487
For cohort CCd_coded = 1	.982	.793	1.216
For cohort CCd_coded = 2	1.019	.817	1.270
N of Valid Cases	327		

20. OCCUPATION _CPB

Crosstab

			CPb_coded		Total
			1	2	
Occupation_coded	1	Count	82	81	163
		Expected Count	82.7	80.3	163.0
		% within Occupation_coded	50.3%	49.7%	100.0%
	2	Count	84	80	164
		Expected Count	83.3	80.7	164.0
		% within Occupation_coded	51.2%	48.8%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Occupation_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.027[a]	1	.869		
Continuity Correction[b]	.003	1	.957		
Likelihood Ratio	.027	1	.869		
Fisher's Exact Test				.912	.478
Linear-by-Linear Association	.027	1	.869		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 80.25.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Occupation_coded (1 / 2)	.964	.625	1.487
For cohort CPb_coded = 1	.982	.793	1.216
For cohort CPb_coded = 2	1.019	.817	1.270
N of Valid Cases	327		

21. DISEASE_NCCD

Crosstab

			NCCd_coded		Total
			1	2	
Disease_coded	1	Count	148	149	297
		Expected Count	150.8	146.2	297.0
		% within Disease_coded	49.8%	50.2%	100.0%
	2	Count	18	12	30
		Expected Count	15.2	14.8	30.0
		% within Disease_coded	60.0%	40.0%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Disease_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.127[a]	1	.288		
Continuity Correction[b]	.757	1	.384		
Likelihood Ratio	1.135	1	.287		
Fisher's Exact Test				.340	.192
Linear-by-Linear Association	1.124	1	.289		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.77.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Disease_coded (1 / 2)	.662	.308	1.423
For cohort NCCd_coded = 1	.831	.607	1.137
For cohort NCCd_coded = 2	1.254	.798	1.972
N of Valid Cases	327		

22. DISEASE _NCPB

Crosstab

			NCPb_coded		Total
			1	2	
Disease_coded	1	Count	149	148	297
		Expected Count	151.7	145.3	297.0
		% within Disease_coded	50.2%	49.8%	100.0%
	2	Count	18	12	30
		Expected Count	15.3	14.7	30.0
		% within Disease_coded	60.0%	40.0%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within Disease_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.054[a]	1	.305		
Continuity Correction[b]	.697	1	.404		
Likelihood Ratio	1.062	1	.303		
Fisher's Exact Test				.342	.202
Linear-by-Linear Association	1.051	1	.305		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.68.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Disease_coded (1 / 2)	.671	.312	1.442
For cohort NCPb_coded = 1	.836	.611	1.144
For cohort NCPb_coded = 2	1.246	.792	1.959
N of Valid Cases	327		

23. DISEASE _CCD

Crosstab

			CCd_coded		Total
			1	2	
Disease_coded	1	Count	148	149	297
		Expected Count	150.8	146.2	297.0
		% within Disease_coded	49.8%	50.2%	100.0%
	2	Count	18	12	30
		Expected Count	15.2	14.8	30.0
		% within Disease_coded	60.0%	40.0%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Disease_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.127[a]	1	.288		
Continuity Correction[b]	.757	1	.384		
Likelihood Ratio	1.135	1	.287		
Fisher's Exact Test				.340	.192
Linear-by-Linear Association	1.124	1	.289		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.77.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Disease_coded (1 / 2)	.662	.308	1.423
For cohort CCd_coded = 1	.831	.607	1.137
For cohort CCd_coded = 2	1.254	.798	1.972
N of Valid Cases	327		

24. DISEASE _CPB

Crosstab

			CPb_coded		Total
			1	2	
Disease_coded	1	Count	148	149	297
		Expected Count	150.8	146.2	297.0
		% within Disease_coded	49.8%	50.2%	100.0%
	2	Count	18	12	30
		Expected Count	15.2	14.8	30.0
		% within Disease_coded	60.0%	40.0%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Disease_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.127[a]	1	.288		
Continuity Correction[b]	.757	1	.384		
Likelihood Ratio	1.135	1	.287		
Fisher's Exact Test				.340	.192
Linear-by-Linear Association	1.124	1	.289		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.77.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Disease_coded (1 / 2)	.662	.308	1.423
For cohort CPb_coded = 1	.831	.607	1.137
For cohort CPb_coded = 2	1.254	.798	1.972
N of Valid Cases	327		

25. CIGARETTE_NCCD

Crosstab

			NCCd_coded		
			1	2	Total
Cigarette_coded	1	Count	108	68	176
		Expected Count	89.3	86.7	176.0
		% within Cigarette_coded	61.4%	38.6%	100.0%
	2	Count	58	93	151
		Expected Count	76.7	74.3	151.0
		% within Cigarette_coded	38.4%	61.6%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Cigarette_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	17.131[a]	1	.000		
Continuity Correction[b]	16.225	1	.000		
Likelihood Ratio	17.281	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	17.079	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 74.35.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Cigarette_coded (1 / 2)	2.547	1.629	3.981
For cohort NCCd_coded = 1	1.598	1.265	2.018
For cohort NCCd_coded = 2	.627	.501	.785
N of Valid Cases	327		

26. CIGARETTE _NCPB

Crosstab

			NCPb_coded		Total
			1	2	
Cigarette_coded	1	Count	108	68	176
		Expected Count	89.9	86.1	176.0
		% within Cigarette_coded	61.4%	38.6%	100.0%
	2	Count	59	92	151
		Expected Count	77.1	73.9	151.0
		% within Cigarette_coded	39.1%	60.9%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within Cigarette_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	16.160[a]	1	.000		
Continuity Correction[b]	15.281	1	.000		
Likelihood Ratio	16.291	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	16.111	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 73.88.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Cigarette_coded (1 / 2)	2.477	1.585	3.869
For cohort NCPb_coded = 1	1.570	1.246	1.979
For cohort NCPb_coded = 2	.634	.506	.795
N of Valid Cases	327		

27. CIGARETTE _CCD

Crosstab

			CCd_coded		Total
			1	2	
Cigarette_coded	1	Count	108	68	176
		Expected Count	89.3	86.7	176.0
		% within Cigarette_coded	61.4%	38.6%	100.0%
	2	Count	58	93	151
		Expected Count	76.7	74.3	151.0
		% within Cigarette_coded	38.4%	61.6%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Cigarette_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	17.131[a]	1	.000		
Continuity Correction[b]	16.225	1	.000		
Likelihood Ratio	17.281	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	17.079	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 74.35.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Cigarette_coded (1 / 2)	2.547	1.629	3.981
For cohort CCd_coded = 1	1.598	1.265	2.018
For cohort CCd_coded = 2	.627	.501	.785
N of Valid Cases	327		

28. CIGARETTE _CPB

Crosstab

			CPb_coded		Total
			1	2	
Cigarette_coded	1	Count	108	68	176
		Expected Count	89.3	86.7	176.0
		% within Cigarette_coded	61.4%	38.6%	100.0%
	2	Count	58	93	151
		Expected Count	76.7	74.3	151.0
		% within Cigarette_coded	38.4%	61.6%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within Cigarette_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	17.131[a]	1	.000		
Continuity Correction[b]	16.225	1	.000		
Likelihood Ratio	17.281	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	17.079	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 74.35.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Cigarette_coded (1 / 2)	2.547	1.629	3.981
For cohort CPb_coded = 1	1.598	1.265	2.018
For cohort CPb_coded = 2	.627	.501	.785
N of Valid Cases	327		

29. SMOKEDURATION_NCCD

Crosstab

			NCCd_coded		Total
			1	2	
SmokDuration_coded	1	Count	92	74	166
		Expected Count	84.3	81.7	166.0
		% within SmokDuration_coded	55.4%	44.6%	100.0%
	2	Count	74	87	161
		Expected Count	81.7	79.3	161.0
		% within SmokDuration_coded	46.0%	54.0%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokDuration_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.926[a]	1	.087		
Continuity Correction[b]	2.560	1	.110		
Likelihood Ratio	2.930	1	.087		
Fisher's Exact Test				.097	.055
Linear-by-Linear Association	2.917	1	.088		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.27.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokDuration_coded (1 / 2)	1.462	.946	2.260
For cohort NCCd_coded = 1	1.206	.972	1.497
For cohort NCCd_coded = 2	.825	.661	1.030
N of Valid Cases	327		

30. SMOKEDURATION _NCPB

Crosstab

			NCPb_coded		Total
			1	2	
SmokDuration_coded	1	Count	93	73	166
		Expected Count	84.8	81.2	166.0
		% within SmokDuration_coded	56.0%	44.0%	100.0%
	2	Count	74	87	161
		Expected Count	82.2	78.8	161.0
		% within SmokDuration_coded	46.0%	54.0%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within SmokDuration_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.311[a]	1	.069		
Continuity Correction[b]	2.921	1	.087		
Likelihood Ratio	3.316	1	.069		
Fisher's Exact Test				.077	.044
Linear-by-Linear Association	3.301	1	.069		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 78.78.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokDuration_coded (1 / 2)	1.498	.969	2.316
For cohort NCPb_coded = 1	1.219	.983	1.511
For cohort NCPb_coded = 2	.814	.651	1.017
N of Valid Cases	327		

31. SMOKEDURATION _CCD

Crosstab

			CCd_coded		Total
			1	2	
SmokDuration_coded	1	Count	92	74	166
		Expected Count	84.3	81.7	166.0
		% within SmokDuration_coded	55.4%	44.6%	100.0%
	2	Count	74	87	161
		Expected Count	81.7	79.3	161.0
		% within SmokDuration_coded	46.0%	54.0%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokDuration_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.926[a]	1	.087		
Continuity Correction[b]	2.560	1	.110		
Likelihood Ratio	2.930	1	.087		
Fisher's Exact Test				.097	.055
Linear-by-Linear Association	2.917	1	.088		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.27.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokDuration_coded (1 / 2)	1.462	.946	2.260
For cohort CCd_coded = 1	1.206	.972	1.497
For cohort CCd_coded = 2	.825	.661	1.030
N of Valid Cases	327		

32. SMOKEDURATION _CPB

Crosstab

			CPb_coded		Total
			1	2	
SmokDuration_coded	1	Count	92	74	166
		Expected Count	84.3	81.7	166.0
		% within SmokDuration_coded	55.4%	44.6%	100.0%
	2	Count	74	87	161
		Expected Count	81.7	79.3	161.0
		% within SmokDuration_coded	46.0%	54.0%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokDuration_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.926[a]	1	.087		
Continuity Correction[b]	2.560	1	.110		
Likelihood Ratio	2.930	1	.087		
Fisher's Exact Test				.097	.055
Linear-by-Linear Association	2.917	1	.088		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 79.27.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokDuration_coded (1 / 2)	1.462	.946	2.260
For cohort CPb_coded = 1	1.206	.972	1.497
For cohort CPb_coded = 2	.825	.661	1.030
N of Valid Cases	327		

33. SMOKEMINUTES_NCCD

Crosstab

			NCCd_coded		Total
			1	2	
SmokMinutes_coded	1	Count	137	59	196
		Expected Count	99.5	96.5	196.0
		% within SmokMinutes_coded	69.9%	30.1%	100.0%
	2	Count	29	102	131
		Expected Count	66.5	64.5	131.0
		% within SmokMinutes_coded	22.1%	77.9%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokMinutes_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	71.661[a]	1	.000		
Continuity Correction[b]	69.762	1	.000		
Likelihood Ratio	74.941	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	71.441	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.50.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokMinutes_coded (1 / 2)	8.167	4.889	13.643
For cohort NCCd_coded = 1	3.157	2.261	4.410
For cohort NCCd_coded = 2	.387	.307	.488
N of Valid Cases	327		

34. SMOKEMINUTES _NCPB

Crosstab

			NCPb_coded		Total
			1	2	
SmokMinutes_coded	1	Count	138	58	196
		Expected Count	100.1	95.9	196.0
		% within SmokMinutes_coded	70.4%	29.6%	100.0%
	2	Count	29	102	131
		Expected Count	66.9	64.1	131.0
		% within SmokMinutes_coded	22.1%	77.9%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within SmokMinutes_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	73.216[a]	1	.000		
Continuity Correction[b]	71.297	1	.000		
Likelihood Ratio	76.577	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	72.992	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.10.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokMinutes_coded (1 / 2)	8.369	5.005	13.992
For cohort NCPb_coded = 1	3.181	2.278	4.441
For cohort NCPb_coded = 2	.380	.301	.480
N of Valid Cases	327		

35. SMOKEMINUTES _CCD

Crosstab

			CCd_coded		Total
			1	2	
SmokMinutes_coded	1	Count	137	59	196
		Expected Count	99.5	96.5	196.0
		% within SmokMinutes_coded	69.9%	30.1%	100.0%
	2	Count	29	102	131
		Expected Count	66.5	64.5	131.0
		% within SmokMinutes_coded	22.1%	77.9%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokMinutes_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	71.661[a]	1	.000		
Continuity Correction[b]	69.762	1	.000		
Likelihood Ratio	74.941	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	71.441	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.50.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokMinutes_coded (1 / 2)	8.167	4.889	13.643
For cohort CCd_coded = 1	3.157	2.261	4.410
For cohort CCd_coded = 2	.387	.307	.488
N of Valid Cases	327		

36. SMOKEMINUTES _CPB

Crosstab

			CPb_coded		Total
			1	2	
SmokMinutes_coded	1	Count	137	59	196
		Expected Count	99.5	96.5	196.0
		% within SmokMinutes_coded	69.9%	30.1%	100.0%
	2	Count	29	102	131
		Expected Count	66.5	64.5	131.0
		% within SmokMinutes_coded	22.1%	77.9%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokMinutes_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	71.661[a]	1	.000		
Continuity Correction[b]	69.762	1	.000		
Likelihood Ratio	74.941	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	71.441	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.50.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokMinutes_coded (1 / 2)	8.167	4.889	13.643
For cohort CPb_coded = 1	3.157	2.261	4.410
For cohort CPb_coded = 2	.387	.307	.488
N of Valid Cases	327		

37. SMOKETIMES_NCCD

Crosstab

			NCCd_coded		Total
			1	2	
SmokTimes_coded	1	Count	128	69	197
		Expected Count	100.0	97.0	197.0
		% within SmokTimes_coded	65.0%	35.0%	100.0%
	2	Count	38	92	130
		Expected Count	66.0	64.0	130.0
		% within SmokTimes_coded	29.2%	70.8%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokTimes_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	40.034[a]	1	.000		
Continuity Correction[b]	38.616	1	.000		
Likelihood Ratio	40.993	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	39.911	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.01.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokTimes_coded (1 / 2)	4.491	2.785	7.244
For cohort NCCd_coded = 1	2.223	1.669	2.960
For cohort NCCd_coded = 2	.495	.397	.617
N of Valid Cases	327		

38. SMOKETIMES _NCPB

Crosstab

			NCPb_coded		Total
			1	2	
SmokTimes_coded	1	Count	129	68	197
		Expected Count	100.6	96.4	197.0
		% within SmokTimes_coded	65.5%	34.5%	100.0%
	2	Count	38	92	130
		Expected Count	66.4	63.6	130.0
		% within SmokTimes_coded	29.2%	70.8%	100.0%
Total		Count	167	160	327
		Expected Count	167.0	160.0	327.0
		% within SmokTimes_coded	51.1%	48.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	41.188[a]	1	.000		
Continuity Correction[b]	39.750	1	.000		
Likelihood Ratio	42.177	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	41.062	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 63.61.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokTimes_coded (1 / 2)	4.593	2.846	7.413
For cohort NCPb_coded = 1	2.240	1.683	2.982
For cohort NCPb_coded = 2	.488	.391	.609
N of Valid Cases	327		

39. SMOKETIMES _CCD

Crosstab

			CCd_coded		Total
			1	2	
SmokTimes_coded	1	Count	128	69	197
		Expected Count	100.0	97.0	197.0
		% within SmokTimes_coded	65.0%	35.0%	100.0%
	2	Count	38	92	130
		Expected Count	66.0	64.0	130.0
		% within SmokTimes_coded	29.2%	70.8%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokTimes_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	40.034[a]	1	.000		
Continuity Correction[b]	38.616	1	.000		
Likelihood Ratio	40.993	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	39.911	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.01.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokTimes_coded (1 / 2)	4.491	2.785	7.244
For cohort CCd_coded = 1	2.223	1.669	2.960
For cohort CCd_coded = 2	.495	.397	.617
N of Valid Cases	327		

40. SMOKETIMES _CPB

Crosstab

			CPb_coded		Total
			1	2	
SmokTimes_coded	1	Count	128	69	197
		Expected Count	100.0	97.0	197.0
		% within SmokTimes_coded	65.0%	35.0%	100.0%
	2	Count	38	92	130
		Expected Count	66.0	64.0	130.0
		% within SmokTimes_coded	29.2%	70.8%	100.0%
Total		Count	166	161	327
		Expected Count	166.0	161.0	327.0
		% within SmokTimes_coded	50.8%	49.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	40.034[a]	1	.000		
Continuity Correction[b]	38.616	1	.000		
Likelihood Ratio	40.993	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	39.911	1	.000		
N of Valid Cases	327				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.01.

b. Computed only for a 2x2 table

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for SmokTimes_coded (1 / 2)	4.491	2.785	7.244
For cohort CPb_coded = 1	2.223	1.669	2.960
For cohort CPb_coded = 2	.495	.397	.617
N of Valid Cases	327		

VITA

NAME	Panji Putra Bagus Karya Mukti
DATE OF BIRTH	5 May 1998
PLACE OF BIRTH	Pacitan, East Java, Indonesia
AWARD RECEIVED	Outstanding Award 3 Poster Presentation