


The Characteristics of the General Population in Medan Undergoing Lung Cancer Screening With Naru

Mica Febiyanti^{1*}, Setia Putra Tarigan², Noni Novisari Soeroso², Putri Chairani Eyanoe³

¹ Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, Universitas Sumatera Utara.

² Division of Pulmonary Oncology, Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, Universitas Sumatera Utara.

³ Departement of Community and Preventive Medicine, Faculty of Medicine, Universitas Sumatera Utara.

*Corresponding Author: Mica Febiyanti, E-mail: drmicafebiy@gmail.com 

ARTICLE INFO

Article history:

Received
20 September 2024

Revised
29 September 2024

Accepted
30 October 2024

Manuscript ID:
JSOCMED-200924-310-2

Checked for Plagiarism: Yes

Language Editor:
Rebecca

Editor-Chief:
Prof. Aznan Lelo, PhD

Keywords

ABSTRACT

Introduction: Indonesia introduced the NARU lung cancer screening form to assess individual risk levels for lung cancer, classifying them as low, medium, or high risk. This study aimed to analyze the characteristics of low, medium and high risk groups in Medan city.

Methods: A quantitative, descriptive cross-sectional design was used, involving 100 individuals from primary health care facilities across 11 areas, who were evaluated using the 9-question NARU form. Evaluation concluded the individuals into low, medium, and high risk of lung cancer.

Results: The majority of the responded high-risk group for lung cancer, the majority were males aged 45-65 years. They had no personal or family history of cancer but were active smokers, worked in carcinogenic environments, and did not live in homes or environments with carcinogenic risks. Additionally, they had a history of COPD and/or TB. In the moderate-risk group, both males and females aged 45-65 years were included, with no personal or family cancer history. They were passive smokers, did not work in carcinogenic environments, and did not live in homes or environments with carcinogenic risks. None had a history of COPD or TB. In the low-risk group, the majority were females under 45 years. They had no personal or family cancer history, were non-smokers, did not work in carcinogenic environments, and did not live in homes or environments with carcinogenic risks. They also had no history of COPD or TB.

Conclusion: The study concluded that in Medan, 48% of the population fell into the moderate-risk group for lung cancer, while 31% were in the low-risk group, and 21% were classified as high risk.

High risk, Lung cancer, Screening, Risk factors, NARU

How to cite: Febiyanti M, Tarigan SP, Soeroso NN. Master of Clinical Medicine Anesthesiology and Intensive Therapy Study Program Faculty of Medicine, Universitas Sumatera Utara, H. Adam Malik Hospital, Medan, Indonesia. Journal of Society Medicine. 2024; 3 (10): 294-301. DOI: <https://10.47353/jsocmed.v3i10.165>

INTRODUCTION

Cancer is an uncontrolled growth of cells and can occur in all cells of the body including the lung. Lung cancer is a malignant tumor of the lung that originates from the airway epithelium.[1] Based on data from the Global Cancer Statistics 2020 (GLOBOCAN 2020), lung cancer is the most common cause of cancer after breast cancer and is the number one cause of cancer death in women. In men, lung cancer ranks as the first cause of cancer in men and is the number one cause of cancer death in men worldwide.[2] In Indonesia, lung cancer accounts for 12.6% of cancer deaths, and is the leading cause of cancer death. Total annual cases are expected to almost double from 30,023 in 2018 to 54,983 cases in 2040.[3]

Research by the Department of Pulmonology and Respiratory Medicine FKUI-RSUP Persahabatan found that the number of new cases of lung cancer increased more than 5 times in the last 10 years from 2015.[4] Therefore, it is necessary to assess the risk of lung cancer to screen and early detection of lung cancer

so that it can find lung cancer at an early stage. The US Preventive Services Task Force Recommendation Statement (USPSTF) categorizes high risk of lung cancer based on age, total cumulative exposure to tobacco smoke, and how long the patient has stopped smoking.[5] This recommendation was made based on the results of a randomized control trial (RCT) from the National Lung Screening Trial (NLST) by screening at high risk of lung cancer in these categories, followed by evaluation screening through low-dose computed tomography (LDCT) examination which then found a 20% reduction in mortality compared to evaluation screening with conventional thoracic photographs.[6]

Indonesia through the Association for the Study on Thoracic Oncology (IASTO) and the Indonesian Society of Respiroogy (ISR) submitted a draft consensus on lung cancer screening where the lung cancer screening service flow will be authorized by the National Health Insurance (JKN) where moderate and high risk people will be referred from primary care for LDCT in secondary care.[7] By the end of 2023, a lung cancer screening form currently called NARU (Kenali Paru) consisting of 9 questions with scores that categorize individuals into low risk, medium risk and high risk of lung cancer will be released to primary care facilities through the National Health Insurance.[8] This study aims to determine the characteristics of patients who undergo lung cancer screening using the NARU screening form.

METHODS

This study used primary and secondary data to determine the characteristics of people in Medan city who underwent lung cancer screening using NARU. This study was conducted at first-level health facilities in Medan city from January 2024 to May 2024.

We included Medan city residents aged >20 years and <75 years who signed the informed consent. We excluded subjects who had been diagnosed with lung cancer, or had a CT scan within 6 months. Samples were taken using consecutive sampling technique. Data collected were initial, ethnicity, occupation, and physical activity history in a week. Then, subjects were asked to fill out a NARU lung cancer screening form consisting of age group, gender, history of previous lung cancer, history of lung cancer in the family, smoking status, history of exposure to carcinogens at work, history of exposure to carcinogens in the living environment, history of living in a house with a risk of carcinogen, and history of COPD and tuberculosis.

We only performed descriptive analysis to determine the risk classification based on the screening form, then see the description of risk factors in each category. Risk stratification using the NARU screening form guidelines, including low risk (total score ≤ 11), moderate risk (total score 12-16), and high risk (total score ≥ 17) of lung cancer.

RESULTS

Table 1. Subject Characteristics

Variabel	Total (n)	Percentage (%)
Tribe		
Aceh	1	3,23
Javenese	27	27,0
Betawi	2	2,0
Sundanese	1	1,0
Sumbawa	1	1,0
Bataknese	52	52,0
Minangkabau	10	10,0
Melayu Sumatera	4	4,0
Job		
Seller	1	1,0
Farmer	1	1,0
Employee	95	95,0
Driver	3	3,0
Physical Activity		
Not at all	72	72,0
Once a week	6	6,0
1-2 times a week	16	16,0
≥ 3 times a week	6	6,0

The characteristics used as the sample of this research are the people of Medan city. The number of respondents who sampled the data in this study totalled 100 samples. The samples were taken from 11 primary health care in 11 sub-districts, namely Medan Johor, Medan Tembung, Medan Sunggal, Medan Selayang, Medan Tuntungan, Medan Marelan, Medan Area, Medan Amplas, Medan Helvetia, Medan Perjuangan, and Medan Baru. The reason why the researcher chose this location is to represent the variation of the characteristics of the people in Medan city, as well as the ease of access for the researcher to reach the location.

We included 100 subjects, with 56% female and 46% were >20 - <75 years old. Other characteristics can be seen in Table 1. Fifty two subjects were Bataknesse, 95% subjects were employee, and 72% subjects had no physical activity in a week. Based on NARU lung cancer screening form, 31 subjects had low risk (total score ≤ 11), 48 subjects had moderate risk (total score 12-16), and 21 subjects had high risk (total score ≥ 17) of lung cancer can be seen in Table 2.

Table 2. Risk stratification based on NARU lung cancer screening form

Age	Low Risk (n)	Moderate Risk (n)	High Risk (n)	Total
>65 years old	0 (0.00%)	4 (8.33%)	8(38.10%)	12
45-65 years old	7 (22.58%)	27 (56.25%)	12 (57.14%)	46
<45 years old	24 (77.42%)	17 (35.42)	1 (4.76%)	42
Gender				
Male	3 (9.67%)	24 (50.00%)	17 (80.95%)	44
Female	28 (90.32%)	24 (50.00%)	4 (19.04%)	56
History of Cancer				
Yes (>5 years)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0
Yes (<5 years)	0 (0%)	2 (2%)	0 (0.00%)	2
No	31 (100%)	46 (95.83%)	21 (0%)	90
Family history of cancer				
Lung cancer	0 (0%)	2 (4.17%)	1 (4.76%)	3
Other cancer	5 (16.13%)	7 (14.58%)	3 (14.29%)	15
None	26 (83.87%)	39 (81.25%)	17 (80.95%)	82
Smoking status				
Active smoker	0 (0%)	11 (22.92%)	11 (22.92%)	22
History of smoking	0 (0%)	5 (10.42%)	6 (28.57%)	11
Passive smoking	9 (29.03%)	20 (41.67%)	2 (9.52%)	31
No smoking	22 (70.97%)	12 (25.00%)	2 (9.52%)	36
History of carcinogen exposure in working environment				
Yes	0 (0.00%)	2 (4.17%)	13 (61.90%)	15
Doubt	1 (3.23%)	3 (6.25%)	1 (4.76%)	5
No	30 (96.77%)	43 (89.58%)	7 (33.33%)	80
History of carcinogen exposure in living environment				
Yes	0 (0.00%)	12 (25.00%)	10 (47.62%)	22
Doubt	1 (3.23%)	2 (4.17%)	0 (0.00%)	3
No	30 (96.77%)	34 (70.83%)	11 (52.38%)	75
History of living in a house with a risk of carcinogen				
Yes	0 (0.00%)	12 (12.00%)	10 (47.62%)	22
Doubt	1 (3.23%)	2 (2.00%)	0 (0.00%)	3
No	30(96.77%)	34 (34.00%)	11 (52.38%)	75
History of COPD and/or tuberculosis				
Yes	1 (3.23%)	7 (14.58%)	14 (66.67%)	22
Doubt	0 (0.00%)	3 (6.25%)	3 (14.29%)	6
No	30 (96.77%)	38 (79.17)	4 (19.05%)	72
Variabel	31(31%)	48 (48.00%)	21(21.00%)	100

DISCUSSION

We found 31 subjects had low risk (total score ≤ 11), 48 subjects had moderate risk (total score 12-16), and 21 subjects had high risk (total score ≥ 17) of lung cancer based on NARU screening form. Based on the results of the study, the majority of the low risk group were women, the same number in the medium risk group, and the majority of the high risk group were men. These results are in line with a study conducted by Sholih et al in 2019 where the research sample found lung cancer in men as much as 23%, and lung cancer samples in women were 7%.^[9]

Based on data from the Global Cancer Statistics 2020 (Globocan 2020), lung cancer is the most common cause of cancer after breast cancer and is the number one cause of cancer deaths in women. In men, lung cancer is the first cause of cancer in men and is the number one cause of cancer death in men worldwide.^[9-15] The higher male risk of lung cancer incidence may be attributed to male smoking and exposure to carcinogens in the workplace.^[9] Lung carcinogenesis is a highly complex and specific risk factors such as gender are still a matter of debate. Nevertheless, many studies have shown that sex, and in detail sex hormones, play a decisive role in the development of lung cancer.^[12]

The odds of developing lung cancer in women who were heavy smokers compared with those who never smoked increased 19-fold (OR, 19.10; 95% CI, 16.98-21.49) and were higher compared to men who smoked the same amount of cigarettes (OR, 12.81; 95% CI, 11.52-14.24). There was strong evidence of a difference in the effect of the number of cigarettes smoked on lung cancer between men and women (interaction $P < .0001$), which remained after adjusting for height. Smoking status is still the is still a major risk factor for lung cancer, although in some literature female smokers have been found to be at higher risk of lung cancer.^[12]

Based on the results of the study, it was found that the majority of low risk was the age group < 45 years, the majority of moderate and high risk was the age group 45-65 years. A study conducted by Bade et al stated that lung cancer is more prevalent in the age group > 70 years in both women and men.^[11,12] Only 5% to 10% of lung cancer cases are diagnosed in individuals under the age of 50 years.^[13] Age is one of the major risk factors for carcinogenesis. More than 60% of cancer incidence and over 70% of cancer deaths are in the age group > 65 years. The body's immune system plays an important role in fighting the development of cancer cells. Changes in the immune response due to aging are called immunosenescence, which is a decline in immune function where there are significant changes in B cells and T cells caused by low immune system efficiency and thymic involution where the thymus loses the ability to produce and replace naive T cells in the periphery.^[14,15]

Based on the results of the study, the majority in the low, medium and high risk groups were individuals who had never been diagnosed with other cancers before. There were 2 respondents in the medium risk group who had a history of cancer other than lung cancer < 5 years ago. This is in accordance with the 2018 RISKESDAS data where the prevalence of cancer in Indonesia was found to be 1.82% so that a larger sample size is needed to find a meaningful value for the description of cancer history in each lung cancer risk.^[16-19] Second primary lung cancer (SPLC) was mentioned by Donin et al in a study conducted in the United States by observing lung cancer patients who survived other cancers before, out of 1,450,837 patients diagnosed with cancer other than lung cancer, 25,447 patients developed SPLC. With an average follow-up of 5.7 years of no SPLC and about 7.7 years of progression to SPLC.^[17]

Based on the results of the research, it can be found that the majority of low, medium and high risks do not have a family history of lung cancer, namely 26 respondents (83.37%), 29 respondents (81.25%) and 17 respondents (80.95%) respectively. Based on data from GLOBOCAN, the incidence of lung cancer in men is 16.8% (34.2 out of 100,000 population) 8.85 (13.6 out of 100,000 population), so a larger sample is needed to see the history of lung cancer in the family. Schwartz et al found that a family history of lung cancer was associated 1.5-4 times more likely to increase the risk of lung cancer.^[18] Lung cancer at an older age is not associated with a family history of cancer.^[19] Family history of cancer is a risk factor for lung cancer even after adjustment for smoking exposure.^[18] Family history of cancer is a risk factor for lung cancer has been reported in many studies with lung cancer incidence at a young age. An increase in relative risk is seen even

after adjustment for smoking. High-risk hereditary linkage analysis identified a major susceptibility locus on chromosome 6q.[20-22]

Lung cancer risk is also increased in Li-Fraumeni syndrome, which is characterized by germline mutations in the p53 tumor suppressor gene.[23] The results showed that the majority of the low risk group were non-smokers, the majority of the medium risk group were passive smokers and the majority of the high risk group were active smokers. This is in line with the 2018 riskesdas data where it was found that the proportion of smoking in the Indonesian population aged ≥ 10 years was 24.3%. The number of passive smokers in this study was 31%, this data is in line with the 2018 riskesdas data where it is known that the proportion of the frequency of being near people who smoke in closed rooms in the Indonesian population is 34%. Smoking are the main cause of lung cancer, it is estimated that 90% of lung cancers are caused by smoking.[10] Data from the lung and respiratory department of Persahabatan Hospital shows that 67% of male lung cancer patients and 32% of female lung cancer patients have a history of smoking.[24] Active smokers have a 20 times higher risk of becoming lung cancer compared to non-smokers, while passive smokers (secondhand smoke) have a 20% greater risk of becoming lung cancer compared to non-smokers.[24]

Based on the results of the study, the majority of low risk never worked in carcinogenic areas for > 5 years as many as 30 respondents (96.77%), the majority of moderate risk never worked in the risk area as many as 43 respondents (89.59%) and the majority of high risk had worked in risk areas as many as 13 respondents (61.90%). Erafai et al found that of the 478 lung cancer patients included in the study, 227 patients (47.5%) were exposed to occupational carcinogens and were older than 30 years. Of these, 93.8% were male. The mean age at diagnosis was 58.8 ± 10.2 years. The most common occupations for men were related to stone construction and painting (47.1%), agriculture (30.8%), and transportation (12.8%). Women were more exposed to cleaning products (50%) and coal smoke (42.8%).[25-28] Based on the results of the study, the majority of low, medium and high risks were never living in a risky environment (environment near factories, mines, highways, landfills). These results are in line with research conducted by Marissa et al who examined the distribution of lung cancer based on the risk of risky residences, namely mining areas, found that the majority in the study did not live in an environment at risk of lung cancer.[29-31]

Based on the results of the study the majority of low risk, medium risk and high risk of lung cancer are not living in homes with high risk of lung cancer. Based on the results of the study the majority of low risk, moderate risk and high risk of lung cancer were not living in homes with high risk of lung cancer (poor ventilation / asbestos roof / dirt floor / wood fire stove) as many as 30 respondents (96.77%), 34 respondents (70.83%) and 11 respondents (52.38) respectively. Buana and Harahap in their research mentioned that exposure to radon, asbestos and pollution either at home or work will increase the risk of lung cancer.[31] This discrepancy may be due to the fact that the sample taken was the people of Medan city. The samples taken were Medan city residents, the majority of whom are office workers in Medan city, sociodemographically can be attributed to middle to upper income so that they do not live with conditions such as poor ventilation / asbestos roof / dirt floor / wood fire stove Patient with history of COPD and tuberculosis has higher risk of lung cancer. Rhamadaniah and Syarif proved that pulmonary TB is one of the risk factors for the occurrence of lung cancer.[31-34]

In one study conducted in Taiwan by exploring pulmonary TB associated with an increased risk of lung cancer, it was found that the incidence of lung cancer was about 11 times higher in a cohort of patients with tuberculosis than non-tuberculosis subjects. A clear relationship between the risk of lung cancer incidence in patients with pulmonary tuberculosis continues to develop, in this paper briefly outlined the biological plausibility relationship. There are several potential mechanisms by which TB and a history of other chronic lung diseases may increase the risk for lung cancer. One mechanism is the presence of localized chronic inflammation and oxidative stress.[27]

From this study, it was found that the number of respondents with high risk was 21 respondents (21%). This is in line with Maki et al's research where there was an increase in the prevalence of lung cancer screening by the high-risk population, namely 21.2% in 2021 from 8.4% in 2019.[28] The high-risk criteria in this study adapted from the USPSTF and randomized controlled trial research from NLST, which included high risk in

this study were age 55-79 years, active smokers with at least 30 packs per year, or former smokers who had quit within 15 years. There are several recommendations in determining high risk from several countries. USPFTF categorizes high risk as age 50 - 80 years, active smokers with at least 20 packs per year or former smokers who have quit for 15 years. Slightly different from NLST, where the UK categorizes high risk at age 55 to 74 years, active smokers with at least 30 packs per year or former smokers who have quit smoking before 15 years.[6] The Netherlands in the 2003 Nelson study screened at high risk at age 50 to 75 years, active smokers with more than 15 cigarettes per day for 25 years or more than 10 cigarettes per day for the last 10 years or former smokers less than the last 10 years.[29] Germany through a study that began in 2007-2011 screened at high risk with the criteria of age 50-69 years, active smokers with at least 15 cigarettes per day for at least 25 years, or 30 packs a year for 10 years, or former smokers who have quit in the last 10 years.[35]

Indonesia through PDPI divides high risk into 2 groups. Group A consists of individuals aged >45 years, active or passive smokers, or former smokers <10 years. Group B is individuals who are >40 years old, but have a family history of lung cancer. Individuals with male criteria, namely age >45 years, have a history of smoking, or exposure to smoking in the residential or work environment, have a history of pulmonary fibrosis disease are also included in the high risk of lung cancer.[8]

CONCLUSION

We found 31 subjects had low risk, 48 subjects had moderate risk, and 21 subjects had high risk, of lung cancer based on NARU screening form in Medan city population. The majority of the responded high-risk group for lung cancer, the majority were males aged 45-65 years. They had no personal or family history of cancer but were active smokers, worked in carcinogenic environments, and did not live in homes or environments with carcinogenic risks.

Additionally, they had a history of COPD and/or TB. In the moderate-risk group, both males and females aged 45-65 years were included, with no personal or family cancer history. They were passive smokers, did not work in carcinogenic environments, and did not live in homes or environments with carcinogenic risks. None had a history of COPD or TB. In the low-risk group, the majority were females under 45 years. They had no personal or family cancer history, were non-smokers, did not work in carcinogenic environments, and did not live in homes or environments with carcinogenic risks. They also had no history of COPD or TB.

DECLARATIONS

This study has obeyed procedures and ethics from The Health Research Ethics Committee of Sumatera Utara University. The ethical clearance certificate issued by the committee is No. 397/KEPK/USU/2024.

CONSENT FOR PUBLICATION

The Authors agree to publication in Journal of Society Medicine.

FUNDING

This research has received no external funding

COMPETING INTERESTS

The authors declare that there is no conflict of interest in this report.

ACKNOWLEDGMENTS

None

REFERENCE

1. Kementerian Kesehatan Republik Indonesia. Pedoman Nasional Pelayanan Kedokteran Kanker Paru. 2017; 1: 1-6.

2. Sung H, Ferlay J, Siegel RL. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. 2021; 71: 209-249.
3. World Health Organization. WHO global report on trends in prevalence of tobacco use 2000-2025 third edition WHO global report on trends in prevalence of tobacco use. 2000; 1: 1-9.
4. Kementerian Kesehatan Republik Indonesia. Pedoman Nasional Pelayanan Kedokteran Tata Laksana Kanker Paru. 2023; 1: 1-16.
5. Krist AH, Davidson KW, Mangione CM. Screening for Lung Cancer: US Preventive Services Task Force Recommendation Statement. JAMA - Journal of the American Medical Association. 2021; 325: 962-970.
6. The National Lung Screening Trial Research Team. Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening. New England Journal of Medicine. 2011; 365: 395-409.
7. Kementerian Kesehatan Republik Indonesia. Association for the Study on Thoracic Oncology (IASTO), Association for the Study on Thoracic Oncology (IASTO), Prof. dr. Elisna Syahrudin PhD, SpP. Sosialisasi Nasional Skrining Kanker Paru. Jakarta. 2024; 1: 1-11.
8. Andarini S, Syahrudin E, Aditya N. Indonesian Society of Respiriology (ISR) Consensus Statement on Lung Cancer Screening and Early Detection in Indonesia. Jurnal Respiriologi Indonesia. 2023; 43: 144-150.
9. Ghinan Sholih M, Aryani Perwitasari D, Hendriani R. Risk factors of Lung Cancer in Indonesia: a qualitative study. 2019; 1: 1-13.
10. Sung H, Ferlay J, Siegel RL. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. 2021; 71: 209-249.
11. Siegel RL, Miller KD, Jemal A. Cancer statistics. 2019; 69: 7-34.
12. Bade BC, Dela Cruz CS. Lung Cancer Epidemiology, Etiology, and Prevention. Clinics in Chest Medicine 2020; 41: 1-24.
13. Schottenfeld D. The Etiology and Epidemic of Lung Cancer. In: Pass H, Carbone D, Minna J, et al. (eds) Principles & Practice of Lung Cancer The Official Reference Text of The IASLC. y lippincott williams & wilkins, a wolters kluwer business. 2010; 1: 3-22.
14. Derhovanessian E, Solana R, Larbi A. Immunity, ageing and cancer Immunity and Ageing. 2008; 5: 1-24.
15. Ikeda H, Togashi Y. Aging, cancer, and antitumor immunity. International Journal of Clinical Oncology 2022; 27: 316-322.
16. Kementerian Kesehatan Republik Indonesia. Pedoman Pengendalian Risiko Kanker Paru. Jakarta: Kementerian Kesehatan Republik Indonesia. 2018; 1: 1-18.
17. Donin NM, Kwan L, Lenis AT. Second primary lung cancer in United States Cancer Survivors, 1992-2008. Cancer Causes and Control. 2019; 1: 1-20.
18. Schwartz AG, Bailey-Wilson JE, Amos CI. Genetic Susceptibility to Lung Cancer. In: IASLC Thoracic Oncology. 2018; 1: 46-51.
19. Ang L, Chan CPY, Yau WP. Association between family history of lung cancer and lung cancer risk: a systematic review and meta-analysis. Lung Cancer. 2020; 148: 129-137.
20. Hjelmborg J, Korhonen T, Holst K. Lung cancer, genetic predisposition and smoking: The Nordic Twin Study of Cancer. 2017; 72: 1021-1027.
21. Malhotra J, Malvezzi M, Negri E. Risk factors for lung cancer worldwide. European Respiratory Journal. 2016; 48: 889-902.
22. Nitadori JI, Inoue M, Iwasaki M. Association between lung cancer incidence and family history of lung cancer: Data from a large-scale population-based cohort study. The JPHC study. 2006; 130: 968-975.
23. Soeroso N, Anggraini R. Kanker Paru Pada Perempuan. Medan: USU Press, 2023; 1: 1-29.
24. Kementerian Kesehatan Republik Indonesia. Buku Pedoman Pengendalian Faktor Risiko Kanker Paru. 2018; 1: 1-10.
25. Erefai O, Soulaymani A, Mokhtari A. Occupational exposures and lung cancer in Morocco: An epidemiologic study. Mater Today Proc 2023; 72: 3480-3483.

26. Rhamadani, et al. Studi Tinjauan Pustaka: Risiko Kejadian Kanker Paru pada Penderita Tuberkulosis Paru. 2020; 1: 1-19.
27. Yu YH, Liao CC, Hsu WH. Increased Lung Cancer Risk among Patients with Pulmonary Tuberculosis A Population Cohort Study. JTO. 2010; 1: 1-23.
28. Krist AH, Davidson KW, Mangione CM. Screening for Lung Cancer: US Preventive Services Task Force Recommendation Statement. JAMA Journal of the American Medical Association. 2021; 325: 962-970.
29. Zhao YR, Xie X, De Koning HJ. NELSON lung cancer screening study. Cancer Imaging. 2011; 11: 1-33
30. Becker N, Motsch E, Trotter A. Lung cancer mortality reduction by LDCT screening Results from the randomized German LUSI trial. 2020; 146: 1503-1513.
31. Buana I, Agustian Harahap D. Asbestos, radon dan polusi udara sebagai faktor resiko kanker paru pada perempuan bukan perokok. Unimal. Tesis. 2022; 1: 1-46.
32. Schwartz AG, Bailey-Wilson JE, Amos CI. Genetic Susceptibility to Lung Cancer. In: IASLC Thoracic Oncology. 2018; 1: 46-51.
33. Powell HA, Iyen-Omofoman B, Hubbard RB. The Association Between Smoking Quantity and Lung Cancer in Men and Women. Journal. 2013; 143: 123-129.
34. Ministry of Health of the Republic of Indonesia. National Report on Basic Health Research (Riskesdas) 2018. Jakarta: National Institute of Health Research and Development. 2018; 1: 1-27.
35. Marissa N, fitria E, nur A. The impacts of staying or working in mining and industrial area to cancer. Cancer. 2002; 1: 1-29.