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Urban-Rural Disparities in Smoking Prevalence, Consumption, and Indoor Smoking Practices Among Older Adults in Indonesia

ABSTRACT

Smoking is a major public health concern worldwide and is a leading cause of preventable morbidity and mortality. In Indonesia, smoking rates are among the highest globally; however, little is known about smoking behavior among older adults, particularly across rural and urban settings. This study aimed to examine the prevalence of smoking and its associated factors among older adults in Indonesia, focusing on demographic, socioeconomic, and geographic disparities. A cross-sectional analysis was conducted using data from the Indonesian Health Survey (SKI) 2023, which included 97,339 participants aged 60 years and older. A multi-stage stratified cluster sampling method was employed to ensure representativeness. Smoking behavior, cigarette consumption, and indoor smoking practices were analyzed alongside demographic variables, such as age, sex, education level, marital status, work status, and region. Descriptive statistics and chi-square tests were used, with adjustments for the complex survey design using STATA 15.1.The overall smoking prevalence was 30.98%, with a higher rate in urban areas (17.77%) than in rural areas (13.21%). Daily cigarette consumption was more common than weekly smoking, and 76.23% of the smokers reported smoking indoors. Smoking was significantly associated with a lower educational level, working status, and marital status. Urban residents showed a higher smoking prevalence and consumption pattern than rural residents. This study highlights disparities in smoking behavior among older adults in Indonesia, emphasizing the need for targeted public health interventions. Efforts should focus on reducing indoor smoking, improving access to smoking cessation programs, and addressing socioeconomic factors contributing to smoking behavior, particularly in urban areas

Keywords: Smoking, older adults, Indonesia, rural-urban disparities, smoking cessation, public health

1. INTRODUCTION

Smoking remains a leading preventable cause of morbidity and mortality worldwide, contributing significantly to the global burden of non-communicable diseases (NCDs)(Budreviciute et al., 2020; Ismail et al., 2024), including cardiovascular diseases, chronic respiratory diseases, and cancers(Gan et al., 2022). According to the World Health Organization (WHO), tobacco use is responsible for over 8 million deaths annually. Approximately 80% of the 1.3 billion tobacco users worldwide reside in low- and middle-income countries, where the burden of tobacco-related illness and death is disproportionately high(WHO, 2023). Among older adults, smoking poses a heightened risk due to age-related vulnerabilities such as declining lung function and the cumulative effects of prolonged tobacco exposure(Flexeder et al., 2019). Indonesia has one of the highest smoking prevalence rates globally, particularly among men(Holipah et al., 2020; WHO, 2020). Tobacco use is deeply ingrained in Indonesian culture and influenced by social, economic, and regional factors(Astuti et al., 2020). Although public health campaigns have raised awareness of the dangers of smoking, significant gaps remain in addressing the unique challenges faced by older adults. Additionally, disparities in smoking behaviors between rural and urban areas highlight the need for targeted interventions tailored to specific demographic and geographic subpopulations(Doogan et al., 2017; Lum et al., 2020).

Older adults represent a critical demographic for understanding smoking behaviors and their health consequences(Hunt et al., 2023; Jeong et al., 2022). This age group often exhibits entrenched smoking habits, which makes cessation efforts particularly challenging. Furthermore, smoking among older adults not only affects their health, but also has implications for family members through secondhand smoke exposure, particularly in households where smoking indoors is common(Yamada & Nakazawa, 2024). Despite the

growing recognition of these issues, limited research has focused on smoking behavior among older adults in Indonesia, particularly with stratification by rural and urban residences. This study aimed to analyze the prevalence of smoking and its associated factors among older adults in Indonesia with a specific focus on demographic, socioeconomic, and geographic variables. By examining patterns of smoking behavior, including cigarette consumption and indoor smoking practices, this study sought to provide evidence-based insights to inform public health policies and interventions. These findings are expected to contribute to the development of targeted strategies to reduce smoking prevalence and associated health risks among older adults in Indonesia.

2. METHODS

2.1 Study Design and Sample

This study employed a cross-sectional design, using data from the Indonesian Health Survey (SKI) 2023, a nationally representative survey aimed at assessing health conditions in the Indonesian population. The survey utilized a multistage stratified cluster sampling method to ensure representativeness across diverse geographic and demographic groups in Indonesia. The study population included individuals aged ≥ 60 years, resulting in a final sample size of 97,339 participants.

2.2 Data Collection

Data for the SKI 2023 survey were collected through structured face-to-face interviews administered by trained surveyors. Standardized questionnaires were used to gather information on sociodemographic characteristics, smoking behavior, health-related factors, and other relevant variables. Smoking behavior was self-reported by the participants, including current smoking status, the number of cigarettes consumed daily or weekly, and indoor smoking habits.

2.3 Variables and Measurements

The dependent Variable was Smoking behavior, categorized as "smoker" (current smoker) or "non-smoker" nonsmoker (not currently smoking). The independent Variables were Demographic characteristics: age was categorized into three groups: 60-65 years, 66-70 years, and ≥71 years; and Sex: Male or female. Marital status was classified as unmarried, married, divorced, or other. Education level: Grouped as no education, elementary school, junior high school, senior high school, or university. Work status: Categorized as working or not working. Region: Classified as Sumatra, Java, Bali, and other islands. Smoking indoors: Dichotomized as “yes” or “no.” Cigarette consumption was measured as the number of cigarettes consumed daily or weekly.

2.4 Statistical Analysis

All statistical analyses were conducted using STATA version 15.1. The dataset's survey weights (indicated by the variable "w_final") were applied to account for complex survey design, including stratification, clustering, and unequal probabilities of selection. The Svy set command in STATA was used throughout the analysis to adjust the survey design. The statistical approach included Descriptive Statistics, Frequency distributions and percentages were calculated for key variables to summarize the demographic characteristics and smoking behavior of the study population. Inferential Analysis: Differences in smoking prevalence and other variables across demographic and residential subgroups were assessed using the chi-squared test. A significance level of $p < 0.05$ was considered statistically significant for all tests.

2.5 Ethical Considerations

The 2023 Indonesia Health Survey (SKI) adhered to strict ethical standards to ensure participants' safety, privacy, and well-being. The Indonesian Ministry of Health submitted a formal data request under ticket number 240675B7CC9C4327 along with a confidentiality agreement letter (reference no. FRM/SMKI-PUSDATIN/70/0108/2024). Data requests can be made using the following link: https://www.badankebijakan.kemkes.go.id/data-mikro-ski/

3. RESULTS

Table 1 provides the frequency distribution of various characteristics and the percentage of smoking among older adults in Indonesia stratified by rural and urban residence, with a total sample size of 97,339 individuals.

The age groups were divided–60-65, 66-70, and 71 years or older. The majority (43.99%) of participants were aged 60-65 years. Within this age group, urban areas had a slightly higher percentage of older adults (25.73%) than rural areas (18.26%). Similarly, urban areas had higher proportions in the 66-70 (14.59%) and ≥71 (17.49%) age groups compared to rural areas, with proportions of 10.58% and 13.36%, respectively ($p = 0.0145$). The sample was nearly evenly distributed between males (48.04%) and females (51.96%). Among males, the urban population (27.67%) had a higher percentage than rural areas (20.37%). For females, the urban group again reported higher percentages (30.13%) than rural areas (21.83%). The difference according to sex was not statistically significant ($p = 0.3362$). The education level showed significant differences between rural and urban areas ($p = 0.0001$). In rural areas, 14.9% of the individuals were not educated, compared to 12.32% in urban areas. Those with elementary education comprised the largest group overall, with 21.87% in rural areas and 22.77% in urban areas. Higher educational levels (senior high school and university) were more common in urban areas (10.46% and 5.46%, respectively) than in rural areas (2.0% and 0.87%, respectively). Most participants were married (66.8%), with a slightly higher percentage living in urban areas (38.15%) than in rural areas (28.65%). Divorce or other marital statuses were more common in urban areas (19.04%) than in rural areas (13.24%). The differences in marital status were statistically significant ($p = 0.0001$). The majority of participants were from Java and Bali (63.89%), with urban residents accounting for 41.4% and rural residents for 22.49%. Participants from Sumatra made up 18.76%, with 10.01% in

rural areas and 8.75% in urban areas. Other islands had a smaller representation, with 17.35% overall and slightly more in rural areas (9.7%) than in urban areas (7.65%) (p = 0.0001). Most participants were working (64.66%), with a higher proportion working in urban areas (34.48%) than in rural areas (30.18%). The number of non-working participants was higher in urban areas (23.32%) than in rural areas (12.02%) (p = 0.0001).

Overall, 30.98% of participants were smokers, with rural areas having 13.21% and urban areas 17.77%. Non-smokers were more common, at 69.02% in rural areas and 40.03% in urban areas. However, this difference was not statistically significant (p = 0.2229). Participants in urban areas reported higher cigarette consumption per day (43.58%) than those in rural areas (34.12%). Weekly cigarette consumption was higher in urban areas (13.73%) than in rural areas (8.57%). The differences were statistically significant (P = 0.0001). A significant proportion of the participants smoked indoors (76.23% overall). Among them, 37.37% were from rural areas, and 38.87% were from urban areas. Non-indoor smoking was much less common, with rural areas accounting for 8.33% and urban areas accounting for 15.43% (p = 0.0001). The sample was evenly split, with 45.89% of the participants residing in rural areas and 54.11% in urban areas

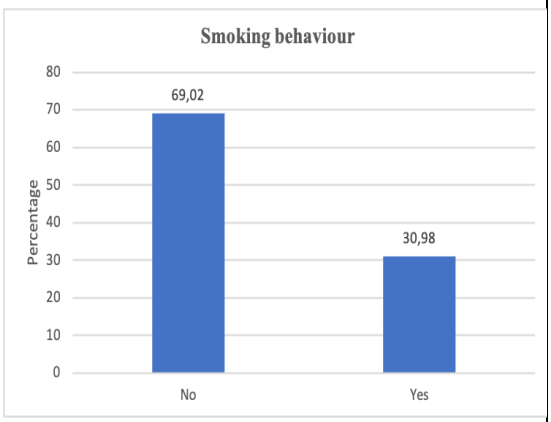
Table 1. Frequency distribution of characteristics and the percentage of smoking among older adults in Indonesia stratified by residence (N=97.339)

Variable	Total		Rural		Urban		*P* value
	n	(%)	n	(%)	n	(%)	
Age (Years)							0.0145
60~65	46.146	43.99	20.770	(18.26)	25.376	(25.73)	
66~70	24.330	25.16	10.988	(10.58)	13.348	(14.59)	
≥ 71	26.863	30.85	12.916	(13.36)	13.947	(17.49)	
Sex							0.3362
Male	47.662	48.04	22.112	(20.37)	25.550	(27.67)	
Female	49.677	51.96	22.556	(21.83)	27.121	(30.13)	
Education Level							0.0001
No Education	25.982	27.22	15.135	(14.9)	10.847	(12.32)	
Elementary School	40.880	44.64	21.622	(21.87)	19.258	(22.77)	
Junior High School	10.431	9.35	3.700	(2.56)	6.731	(6.8)	
Senior High School	13.188	12.46	2.948	(2.0)	10.240	(10.46)	
University	6.858	6.33	1.263	(0.87)	5.595	(5.46)	
Marital Status							0.0001
Unmarried	1.222	0.92	500	(0.31)	722	(0.61)	
Married	66.554	66.8	31.006	(28.65)	35.548	(38.15)	
Divorce and other	29.563	32.28	13.162	(13.24)	16.401	(19.04)	
Region							0.0001
Sumatra	27.292	18.76	14.018	(10.01)	13.274	(8.75)	
Java and Bali	36.140	63.89	9.440	(22.49)	26.700	(41.4)	
Other islands	33.907	17.35	21.210	(9.7)	12.697	(7.65)	
Work Status							0.0001

Not Working	31.329	35.34	12.078	(12.02)	19.251	(23.32)	
Working	66.010	64.66	32.590	(30.18)	33.420	(34.48)	
Smoking behaviour							0.2229
No	69.589	69.02	31.789	(28.99)	37.800	(40.03)	
Yes	27.750	30.98	12.879	(13.21)	14.871	(17.77)	
Average cigarettes consumption (unit)							0.0001
Stick/day	21.489	77.7	10.145	(34.12)	11.344	(43.58)	
Sticks/week	6.138	22.3	2.680	(8.57)	3.458	(13.73)	
Smokes indoors							0.0001
Yes	17.189	76.23	8.846	(37.37)	8.343	(38.87)	
No	4.583	23.77	1.771	(8.33)	2.812	(15.43)	
Residence							-
Rural	44.668	45.89	-	-	-	-	
Urban	52.671	54.11	-	-	-	-	

Note: * $p<0.05$

Figure 1 illustrates smoking behaviors, prevalence of smoking, average cigarette consumption, and practice of smoking indoors among older adults in Indonesia. Panel (a) shows the distribution of smoking behavior in the population. The majority of individuals (69.02%) were non-smokers, whereas 30.98% were smokers. Panel (b) presents the prevalence of smoking, stratified by residence. Smoking was more prevalent in the urban areas (17.77%) than in the rural areas (13.21%). Panel (c) shows average cigarette consumption per unit. Daily cigarette consumption accounted for a significant majority (77.7%), whereas weekly cigarette consumption accounted for 22.3%, reflecting a higher preference for daily smoking among older adults. Panel (d) depicts the practice of smoking indoors. A significant proportion (76.23%) of smokers reported smoking indoors, whereas a smaller percentage (23.77%) indicated that they did not smoke indoors.



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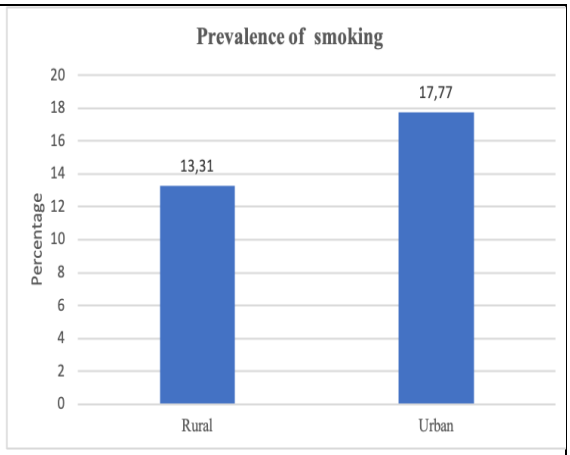

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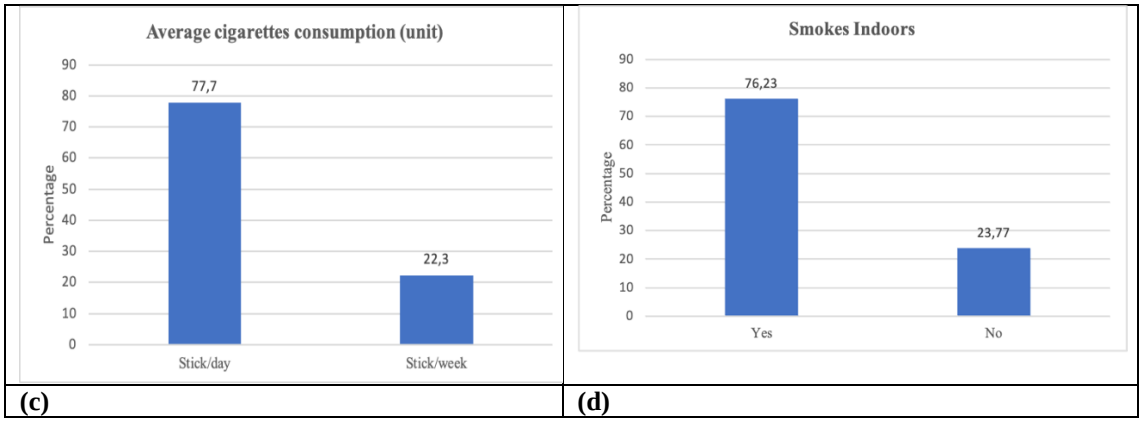

(c) (d)

Figure 1. Smoking behaviour (a), Prevalence of smoking behaviour (b), Average cigarettes consumptions in unit (c), Smokes indoors

4. DISCUSSION

This study provides valuable insights into smoking behavior and related characteristics of older adults in Indonesia, stratified by urban and rural residences. The findings highlight several significant patterns in smoking prevalence, cigarette consumption, and environmental impacts of smoking practices, such as smoking indoors.

The results showed that 30.98% of older adults in Indonesia were smokers, and smoking was more prevalent in urban areas (17.77%) than in rural areas (13.21%). This urban-rural disparity in smoking prevalence aligns with prior studies suggesting that urban residents may have greater access to cigarettes and a potentially higher influence from social and cultural norms promoting smoking(Mumford et al., 2019; VanFrank B, 2024). Urban environments often provide easier access to tobacco products because of their higher commercial availability and advertising, contributing to increased smoking behavior(Vallarta-Robledo et al., 2022). Conversely, rural populations, while also affected by smoking, may face different socioeconomic constraints that reduce tobacco use(Bafunno et al., 2020). The study highlights that smoking is prevalent among both men and women, with urban males being the most frequent smokers. This is consistent with global evidence that smoking remains a male-dominated behavior in many developing countries, although female smoking rates in urban areas are increasing(Agaku et al., 2024; Martini et al., 2022). The higher smoking prevalence in older urban adults may reflect generational differences in exposure to tobacco marketing or shifts in urban lifestyles over time(Cao et al., 2023). Interestingly, the findings suggest that smoking prevalence declines with age, with a higher percentage of smokers in the 60-65 age group than in those aged ≥71 years. This decrease might be due to health complications in older adults leading to smoking cessation or survivorship bias, as long-term smokers may be more susceptible to smoking-related illnesses(Chen et al., 2024; Ding et al., 2019).

Daily cigarette consumption (77.7%) was far more common than weekly consumption (22.3%), indicating that smoking is a regular and ingrained habit. Urban smokers reported higher daily cigarette consumption than their rural counterparts did. This pattern may reflect the economic capacity of urban residents to purchase cigarettes more frequently or the higher stress levels associated with urban living(Theilmann et al., 2022). Furthermore, rural areas, despite having a lower prevalence of smoking, may face unique challenges with cultural

acceptance of smoking, which could influence smoking behavior differently(Buettner-Schmidt et al., 2019; Hirko et al., 2023). The findings revealed a concerning trend: a significant majority of smokers (76.23%) reported smoking indoors, with minimal difference between rural and urban settings. This behavior poses significant health risks to household members, particularly non-smokers and vulnerable populations, such as children and older adults. Indoor smoking leads to secondhand smoke exposure, which increases the risk of respiratory diseases, cardiovascular conditions, and cancer in nonsmokers (Flor et al., 2024). The data underscores the urgent need for targeted public health interventions to reduce indoor smoking, particularly in households where older adults are primary smokers.

Education appears to play a critical role in smoking behavior. Individuals with higher education levels (senior high school or university) were more likely to reside in urban areas and had a lower smoking prevalence than those with less education. This finding is consistent with the existing literature, which demonstrates a negative association between educational level and smoking prevalence. Education not only provides individuals with greater awareness of the health risks associated with smoking, but also fosters access to information and resources to quit smoking(Angeli et al., 2024; Sun et al., 2023). The data revealed that individuals who are working are more likely to smoke than those who are not working. This relationship may stem from the stress associated with employment or workplace environments in which smoking is normalized. Urban workers, in particular, had higher smoking rates, suggesting that workplace smoking cessation programs and stricter enforcement of workplace smoking bans may be effective strategies for reducing smoking prevalence in this demographic(Syamlal et al., 2019).

The findings of this study underscore the urgent need for targeted public health policies to address smoking behavior among older adults in Indonesia. Given the high prevalence of indoor smoking, educational campaigns emphasizing the dangers of secondhand smoke exposure are essential. Policymakers should consider implementing stricter regulations on indoor smoking along with community-based interventions to encourage smoke-free households. Furthermore, efforts should be made to address disparities in smoking behavior between urban and rural populations. While urban residents have a higher smoking prevalence, rural areas may benefit from targeted interventions that address the cultural and economic barriers to smoking cessation. Expanding access to smoking cessation programs, particularly in rural areas, could have a significant impact on reducing smoking prevalence and associated health risks.

Although this study provides a comprehensive analysis of smoking behavior among older adults in Indonesia, several limitations should be acknowledged. First, the cross-sectional design limits the ability to establish causality between demographic factors and smoking behavior. Second, self-reported data may be subject to recall bias or underreporting of smoking behavior, particularly among females in rural areas, where social norms may stigmatize smoking. Future research should consider longitudinal studies to better understand the causal relationships between demographic factors and smoking behavior. Additionally, qualitative research exploring cultural norms and individual attitudes toward smoking could complement the quantitative findings of this study.

5. CONCLUSION

This study highlights the significant prevalence of smoking and its associated behaviors among older adults in Indonesia, revealing important disparities between rural and urban populations. Smoking was more prevalent among urban residents with higher daily cigarette consumption than in rural areas. Furthermore, a proportion of smokers reported smoking indoors, posing serious health risks to household members through exposure to secondhand smoke. Sociodemographic factors, including age, sex, educational level, and marital status, were found to influence smoking behavior. Individuals with lower educational attainment and those who were still working were more likely to smoke, particularly in urban settings, where smoking behavior is more prevalent. These findings underscore the importance of addressing social and economic factors when designing effective smoking cessation programs.

The study also highlights the need for targeted public health interventions, such as stricter enforcement of smoke-free indoor regulations, expansion of smoking cessation programs, and educational campaigns to raise awareness of the health risks associated with smoking and secondhand smoke. Particular attention should be paid to vulnerable groups, including older adults and rural populations, where cultural and socioeconomic barriers may hinder access to resources for smoking cessation. By providing evidence on the patterns and disparities in smoking behavior, this study supports the development of tailored strategies to reduce smoking prevalence among older adults in Indonesia. Efforts to address smoking behavior in this population could lead to significant health improvements and reduce the burden of tobacco-related diseases nationwide.

6. ACKNOWLEDGMENTS

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