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Analysis Of The Impact Of Smoke-Free Area Policies On Smoking Prevalence In Indonesia

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ABSTRACT

Indonesia the highest number of smokers in ASEAN, according BPS in 2023 there are 28.62% of individuals aged 15 and older who smoked tobacco in the past month. The government aims to reduce the smoking prevalence In Indonesia through the implementation of smoke-free area (SFA) policies. Studies in various countries have shown that smoking bans policies significantly reduce smoking prevalence. However, not all regional governments in Indonesia have SFA regulation. This study is to analyze the impact of SFA policies and the duration of their implementation on the prevalence of smoking in Indonesia. This research using Logit regression model and interpreted using Marginal Effects. The findings indicate that SFA policy and the duration have varying effects across different age groups. For the adult, found that SFA policy and the duration had a negative and significant impact on smoking probability. The SFA policy is essential for the government to control the health impacts of tobacco consumption. This study is expected to provide new insights and enrich references and literature on the study of smoking bans and smoking prevalence. Moreover, it can serve as a consideration for the government in its efforts to mitigate the health impacts of tobacco consumption in Indonesia.

INTRODUCTION

The purpose of this study is to analyze the effect of the existence or absence of Smoke-Free Area (SFA) policies and the duration of their implementation on smoking prevalence among individuals in Indonesia, while also considering the socio-economic factors that may influence these outcomes. Smoke-Free Area policies, particularly those enacted at the district and city government levels, are regarded as highly relevant instruments for understanding and controlling cigarette consumption in the broader population. These policies typically regulate smoking behavior in public places such as offices, schools, health facilities, and public

transportation, thereby aiming to reduce exposure to secondhand smoke and discourage smoking habits.

Indonesia continues to face significant public health challenges related to tobacco consumption, with smoking prevalence remaining relatively high compared to many other countries. This condition is influenced not only by cultural acceptance and widespread availability of cigarettes but also by variations in local government commitment to tobacco control. In this context, the presence or absence of SFA policies across regions creates differing environments that may either support or hinder efforts to reduce smoking behavior. Furthermore, the duration of policy implementation is another important factor, as longer-established policies are expected to produce stronger behavioral changes over time due to increased public awareness, enforcement consistency, and normalization of smoke-free norms.

In addition to policy-related variables, socio-economic factors such as income level, education, occupation, age, and gender also play a crucial role in shaping individual smoking behavior. Individuals with lower levels of education or income, for instance, may have higher smoking rates due to limited access to health information or stress-related factors. Conversely, those with higher education levels may be more aware of the health risks associated with smoking and therefore less likely to engage in such behavior. By incorporating these socio-economic dimensions into the analysis, this study aims to provide a more comprehensive understanding of smoking prevalence in Indonesia.

This research adopts a quantitative approach, utilizing secondary data from national surveys and regional policy records to examine the relationship between SFA policies and smoking prevalence. Statistical analysis is employed to identify whether significant differences exist between regions with and without SFA policies, as well as to assess how the duration of policy implementation affects smoking behavior over time. The findings of this study are expected to contribute to the development of more effective tobacco control strategies, particularly at the local government level.

Ultimately, this study highlights the importance of consistent policy implementation and socio-economic considerations in reducing smoking prevalence. The results are anticipated to provide valuable insights for policymakers, public health practitioners, and researchers in designing targeted interventions that can strengthen tobacco control efforts and improve public health outcomes in Indonesia.

LITERATURE REVIEW

Indonesia ranks first with the highest number of smokers in ASEAN , of the 124 million adult smokers in the Southeast Asia region half live in Indonesia where the number of smokers consists of, 62.9% male smokers and 4.8% female smokers (Tan & Dorotheo, 2021). Based on BPS data, in 2023 the percentage of the population aged 15 years and over who smoked tobacco during the last month in Indonesia reached 28.62%, this number increased by 0.36% when compared to the previous year, and was dominated by smokers who lived in rural areas, namely 31.09%, this number was greater than smokers who lived in urban areas, namely 26.87%.

The high number of smokers in Indonesia occurs due to a significant increase in tobacco consumption in the last three decades, there are several factors that influence, such as population growth, relatively cheap cigarette prices, extensive and intensive tobacco marketing by the tobacco industry, and lack of public knowledge about the adverse effects of tobacco (Kosen, 2018). The adverse effects of cigarette consumption in terms of health, causing various diseases that are harmful to the human body, such as heart attacks, strokes, oral cancer, throat cancer, lung cancer, tuberculosis, asthma, decreased fertility rates, birth abnormalities, vision loss, hearing loss, gastrointestinal diseases, damage to the skin, infant mortality and weakening of the immune system (WHO, 2019).

Tobacco use has also made millions of people sick, with more than 8 million people dying from diseases caused by tobacco use each year. The number of deaths is expected to increase each year, even as the number of tobacco users declines, because tobacco kills its users and people exposed to tobacco emissions slowly (World Health Organisation, 2021). The adverse impact of cigarette consumption in economic terms is the financial burden caused by smoking. The economic costs of smoking are divided into two categories, namely direct costs and indirect costs.

Direct costs of smoking, such as decreased consumption of other commodities. Indirect costs are the economic costs incurred due to lost productivity due to the health effects of smoking (Ika & Rizky, 2020). The Indonesian Ministry of Health reported that the total cost of smoking in 2015 reached 596.61 trillion rupiah, which includes: expenditure to buy cigarettes (208.83 trillion rupiah), loss of Disability Adjusted Life Years (DALYs) or lost productive years due to morbidity, disability, and premature death (374.06 trillion rupiah), total medical expenditure due to diseases attributable to tobacco (13.67 trillion rupiah for inpatient services and 53.44 billion rupiah for outpatient services) (Kosen, 2018).

Based on this, efforts to reduce the prevalence of smoking in Indonesia are very important to realize superior and quality Indonesian Human Resources (HR). Human resource development is the government's top priority to improve competitiveness, and education and health are important elements in supporting the achievement of these goals. In relation to reducing smoking prevalence, in line with the Sustainable Development Goals (SDGs) in goal 3, namely good health and well-being, the Government through Presidential Regulation No. 59/2017 on the Implementation of Achieving the Sustainable Development Goals has targeted a reduction in the percentage of smoking in the population aged 18 years and under and again targeted a reduction in the percentage of smoking in the population aged 10-18 years in the RPJMN 2020 - 2024. This is a form of the Government's seriousness to improve the quality of human resources through improving the quality of public health, so that to achieve all the targets that have been determined, policy instruments are needed that can be used to reduce smoking prevalence in Indonesia through controlling tobacco use and consumption. In order to control tobacco use, WHO launched MPOWER (Monitor, Protect, Offer help, Warn, Enforce, Raise taxes) as a package of six most important and effective tobacco control policies. One of the many tobacco control policies also applied in various countries in the world, namely Protect by enforcing smoking ban policies in public places as a form of protection from exposure to tobacco smoke.

The implementation of smoking *ban* policies in public places implemented by various countries in the world, has different terms in accordance with the direction and purpose of the creation of the smoking ban policy, including *Clear Indoor Air Law* (clean indoor air rules), *Smoke Free Area Policy* (smoking free area rules) or *Public Smoking Ban Policy* (smoking ban rules in public places). The smoking ban policy in public places that applies in Indonesia is better known as the Smoke Free Area. A Smoke Free Area is a room or area that is declared prohibited for smoking activities or the activities of producing, selling, advertising and/or promoting tobacco products (Rahajeng, 2016). The implementation of the Smoke Free Area policy in Indonesia is regulated in Law Number 36 of 2009 concerning Health. In this law, all local governments are required to establish Smoke Free Areas in their areas. The policy is intended to provide protection to people who do not smoke from exposure to cigarette smoke caused by smokers.

Table 1 Number of Regions That Have KTR Regulations

No.	Year	Number of Regions Establishing KTR Rules	Number of regions with KTR regulations	Duration of the KTR Rule
1	2008	3	3	15
2	2009	7	10	14
3	2010	9	19	13

4	2011	10	29	12
5	2012	23	52	11
6	2013	29	81	10
7	2014	55	136	9
8	2015	63	199	8
9	2016	67	266	7
10	2017	51	317	6
11	2018	46	363	5
12	2019	31	394	4
13	2020	13	407	3
14	2021	18	425	2
15	2022	12	437	1
16	2023	6	443	0

Source: Ministry of Home Affairs, 2023, processed

The Smoke Free Area policy can also be a tool for the government to control tobacco use, which in this case is aimed at controlling smoking. However, up to 2023, only 443 District/City Governments have regulations on Smokefree Areas and there are still 71 District/City Governments that do not have regulations. This condition is not in line with the target achievements in the roadmap for controlling the impact of tobacco consumption as stipulated in the Minister of Health Decree No. 40/2013 on the Roadmap for Controlling the Impact of Cigarette Consumption on Health, in which the Minister of Health has determined the target achievements that must be achieved based on a predetermined time.

Based on this, by comparing the target achievements with the current conditions, it can be said that not all Local Governments in Indonesia have the same vision in controlling tobacco use through the implementation of smoking ban policies in public places as a form of protection from exposure to tobacco smoke. Research conducted by various countries shows that smoking ban policies have a significant impact in reducing smoking prevalence and reducing exposure to tobacco smoke in public places. Research conducted by (Catalano & Gilleskie, 2021; Celidoni et al., 2020; Rahajeng, 2016; Rocco & D'Hombres, 2014) shows that, the implementation of smoking ban policies has a significant impact on reducing the proportion of smokers.

The implementation of a smoking ban policy is one of the most effective efforts to reduce smoking prevalence (Rocco & D'Hombres, 2014). The effectiveness of the implementation of smoking ban policies also cannot be separated from the supervision and duration of the policy, the results of studies conducted by (Fong et al., 2006; Goodchild et al., 2018; Naiman et al., 2010) show that the longer the policy is implemented, the resulting impact also shows a positive trend. In addition to the impact on reducing smoking prevalence, it also indirectly impacts health and economic aspects, reducing health care costs associated with diseases caused by smoking and reducing hospital admission rates due to cardiovascular and respiratory diseases. However, there are also studies that show different results, such as research conducted by (Carpenter et al., 2011; Palali & van Ours, 2019; Rahmawati, 2019) the study found that smoking ban policies in public places did not significantly affect smoking prevalence.

There have been many studies conducted to see the effect of smoking ban policies in public places on smoking prevalence, but in Indonesia there has been no in-depth research that looks at the effect of the length of the Smoke Free Area policy on smoking prevalence in Indonesia. Based on the description of these problems, this study aims to look at the effectiveness of the Smoke Free Area policy and the length of time the policy is in effect in reducing the prevalence of individual smoking in Indonesia by considering socio-economic factors.

METHODS

The data source used in this study uses individual and household survey micro data sourced from the March 2023 National Socio-Economic Survey (SUSENAS) and data on district and city government regulations regarding Smoke Free Areas which are then combined. In this study, the dependent variable used is the variable of individual smoking and the main independent variables in this study are the presence or absence of a Smoke Free Area regulation and the length of time the policy is in effect as well as other control variables. The model used in this study is a logit regression model and refers to the model built by (Catalano & Gilleskie, 2021), with modifications that refer to other studies that have been described in the previous chapter, so this study uses the following mathematical model:

Equation 1

$$logit(p_i) = ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k \quad (1)$$

the probability of occurrence is derived from the logit function:

$$p_i = \frac{e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_k X_k}}{1+e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_k X_k}} \quad (2)$$

where

$p_i = Pr(Y_i = 1 \mid X)$	:	Probability of individual *i* smoking every day and smoking not every day
$1 - p_i$	:	Probability that individual *i* does not smoke
β_0	:	Intercept
β_k	:	Variable coefficient X_k

In this case, the dependent variable of individuals who smoke is a binary variable, where individuals can be categorized as "smoking" = 1 or "not smoking" = 0, so this research model cannot use a linear equation model. Logit regression was therefore chosen to model binary events as a function of independent variables. Data analysis was carried out using logit regression and using the STATA application, so that from the above mathematical functions, an econometric model was obtained that could be analyzed using the following statistical approach:

$$\begin{aligned} merokok_i = {} & \beta_0 + \beta_1 KTR_i + \beta_2 Lama\_KTR_i + \beta_3 lakilaki_i + \beta_4 umur_i + \beta_5 KRT_i \\ & + \beta_6 pernah\_kawin_i + \beta_7 pendidikan\_menengah_i + \beta_8 pendidikan\_tinggi_i \\ & + \beta_9 status\_kerja_i + \beta_{10} status\_skl_i + \beta_{11} status\_kesehatan_i + \beta_{12} kota_i \\ & + \beta_{13} lnpengeluaran_i + \beta_{14} persentase\_merokok\_kabkota_i \\ & + \beta_{15} dummy\_pjawa_i + \varepsilon_i \end{aligned} \quad (3)$$

where

$merokok_i$	:	Individuals who smoke every day and not every day =1 and do not smoke = 0
$\beta_1 KTR_i$	:	Existence of a Smoke Free Area Policy at the City District level
$\beta_2 Lama\_KTR_i$	:	Length of time the Smoke Free Area policy has been in effect at the district/city level
$\beta_3 lakilaki_i$	:	Gender of the individual, male = 1 female =0
$\beta_4 umur\_kat_i$	:	Age consists of 3 categories, namely category 1: Teenagers 10 - 18 years old,

		category 2: young adults 19 - 40 years old category 3 : adults 41 years and above
$\beta_5 \mathrm{KRT}_i$	:	Status of position in the household, Head of Household (KRT) = 1 other = 0
$\beta_6 pernah\_kawin_i$	:	Marital status of individuals, individuals who are married, divorced and widowed = 1 not married = 0
$\beta_7 pendidikan\_menegah_i$	:	Education level of the individual, secondary education at junior high school level up to senior high school level or equivalent = 1 and low education at elementary school level and below = 0
$\beta_8 pendidikan\_tinggi_i$	:	The education level of the individual, high education at the Diploma level up to S3 = 1 and low education at the elementary level and below = 0
$\beta_9 status\_kerja_i$	:	Individual activities in the past week, working = 1 and other (taking care of household, other activities and not working) = 0
$\beta_{10} status\_skl_i$	:	Individual activities in the past week, school = 1 and other (housekeeping, other activities and not working) = 0
$\beta_{11} status\_kesehatan_i$	:	Individual health status, sick and interfering with activities = 1 and not sick = 0
$\beta_{12} kota_i$	:	Individual's place of residence, city = 1 village = 0
$\beta_{13} lnpengeluaran_i$	:	Expenditure per month
$\beta_{14} persentase\_merokok\_kabkota_i$	:	Percentage of people smoking rate in districts
$\beta_{15} dummy\_pjawa_i$	:	Individual's place of residence, in Java = 1 other = 0
ε_{it}	:	Error

Furthermore, to interpret the logit regression model, it is necessary to use marginal *effects*. The marginal effect is used to understand the magnitude of the effect of each change in the independent variable *X* on the probability of the dependent variable *Y*. The marginal effect is calculated by taking the derivative of the probability function on the independent variable , as follows:

Equation 4

$$\frac{\partial p_i}{\partial X_k} = p_i(1 - p_i).\beta_k \quad (4)$$

p_i : Probability of occurrence

$1 - p_i$: Probability of not occurring

β_k : Coefficient of the independent variable

The marginal effect indicates the change in probability when the independent variable increases by one unit, this result must be multiplied by the probability density function to obtain the marginal effect.

RESULTS

Descriptive Statistics

Table 2 Summary Descriptive Statistics

Variables	Observation	Mean	Std Dev	Min	Max
Smoking	1,016,234	0,2450	0,4301	0	1
KTR	1,016,234	0,8746	0,3312	0	1
Duration_of_KTR	1,016,234	5,4093	3,5169	0	15
Male	1,016,234	0,4987	0,5000	0	1
Age	1,016,234	2,2316	0,7680	1	3
KRT	1,016,234	0,3363	0,4725	0	1
ever_married	1,016,234	0,6641	0,4723	0	1
secondary_education	1,016,234	0,4446	0,4969	0	1
higher_education	1,016,234	0,2908	0,4541	0	1
employment_status	1,016,234	0,5173	0,4997	0	1
school_leaving_status	1,016,234	0,1874	0,3903	0	1
health_status	1,016,234	0,1039	0,3051	0	1
City	1,016,234	0,4196	0,4935	0	1
household_income	1,016,234	15,2936	0,6183	11,7266	19,6132
smoking_rate_by_district_and_city	1,016,234	0,2288	0,0440	0,0454	0,3380
Java_dummy	1,016,234	0,2918	0,4546	0	1

Source: SUSENAS March 2023 processed

This section presents descriptive analysis to provide an overview of information and relationships between research variables. In the table above, there are 1,016,234 observations from 514 districts and 34 provinces in Indonesia. The average number of individuals who smoke tobacco every day and not every day in Indonesia is 24.50%. Meanwhile, of the 514 districts and cities in Indonesia, until 2023, there are 443 local governments or around 86.2% of districts and cities that have a Smoke Free Area policy in the form of either a Regional Regulation or a Regional Head Regulation and there are still 71 local governments that do not have a Smoke Free Area policy in the form of either a Regional Regulation or a Regional Head Regulation.

The age variable in this study is divided into 3 (three) categories, namely category 1 individuals aged 10 - 18 years, category 2 individuals aged 19 - 40 years and category 3 individuals aged 41 years and over. Based on these age categories, individuals in category 3 are the largest group of individuals with a percentage of 43.76% of the total observations. Based on this description, to determine the effect of each of these variables on smoking prevalence, regression has been carried out using a logit regression model, from the regression results it was

found that there are several variables that have a large significance effect and positively influence the individual's decision to smoke. Furthermore, to explain the logit regression results of each independent variable on the dependent variable (smoking), the Marginal Effect is used to interpret the regression results.

Table 3 Marginal Effect Estimation Results

	10-18 Years	19-40 Years	41 and above
	dy/dx (1)	dy/dx (2)	dy/dx (3)
KTR	0,000237 (0,00017)	-0,002463 (0,0017)	-0,003445*** (0,00183)
KTR_Duration	0,000058 (0,00002)	0,000485** (0,00016)	-0,000334** (0,00016)
Male	0,019872* (0,00049)	0,560858* (0,00194)	0,492436* (0,00207)
KRT	0,015499* (0,00419)	0,026093* (0,00158)	0,035137* (0,00176)
ever_married	0,007746* (0,00154)	0,019762* (0,00131)	-0,036941* (0,0037)
secondary_education	0,002815* (0,00019)	-0,034338* (0,00143)	-0,009870* (0,00109)
higher_education	-0,003554* (0,0002)	-0,056056* (0,00121)	-0,026818* (0,00111)
employment_status	0,015793* (0,001)	0,058489* (0,00126)	0,080258* (0,00119)
skill_level	-0,009022* (0,00052)	-0,064770* (0,00145)	
health_status	0,00034*** (0,0002)	-0,001748 (0,00175)	-0,023358* (0,00119)
City	-0,000471* (0,00011)	-0,012598* (0,00096)	-0,014769* (0,00101)
household_expenditure	0,00034* (0,00009)	0,009612* (0,0008)	0,012039* (0,00075)
smoking_rate_district_city	0,035907* (0,00198)	0,816163* (0,01358)	1,029666* (0,01347)
Java_dummy	0,001974* (0,00017)	-0,001073 (0,00105)	-0,009332* (0,00103)
Observation	209,252	362,324	444,658

Type: *p<0.01, **p<0.05, ***p<0.1
Source: SUSENAS March 2023 processed

The results of this interpretation show quite diverse results. There are several variables that have different effects and significant levels on smoking prevalence based on age categories, such as the KTR variable, Lama_KTR, and health status in these variables. In addition to these variables, there are also variables that have the same effect and significance level on smoking prevalence, namely the variables of male, head of household, higher education, work status, city, expenditure and percentage of smoking_kabkota.

The Effect of Smokefree Area Policies on Smoking Prevalence

The Smoke Free Area policy has different effects and levels of significance on smoking prevalence based on age category. In individuals with an age category of 10 - 18 years, namely adolescents, it was found that the effect of the presence or absence of the Smoke Free Area policy was very small and insignificant, so it did not affect the prevalence of smoking in adolescents. In individuals with the age category 19 - 40 years old, namely young adults, it was also found that the Smoke Free Area policy did not have a significant impact on the probability of individuals to smoke.

The insignificant effect of the smoking ban policy on smoking prevalence indicates that the presence or absence of a Smokefree Area policy in a District and Municipal Government has no influence on the prevalence of smoking in the adolescent and young adult age groups. These results are in line with research conducted by (Carpenter et al., 2011; Palali & van Ours, 2019; Rahmawati, 2019), in which the study found insignificant results from the existence of a smoking ban policy, be it a Smoke Free Area policy or other terms.

The insignificant effect of the Smoke Free Area policy on smoking prevalence in the age category of adolescents and young adults is caused by various things. The results of research conducted by (Buddelmeyer & Wilkins, 2021; Tabuchi et al., 2014) found that smoking bans increase the probability of quitting smoking but do not apply to all age groups, the cause of differences in response to smoking bans between age groups is resistance. Adolescents and young adults may be more likely to smoke as a form of rebellion against the rules.

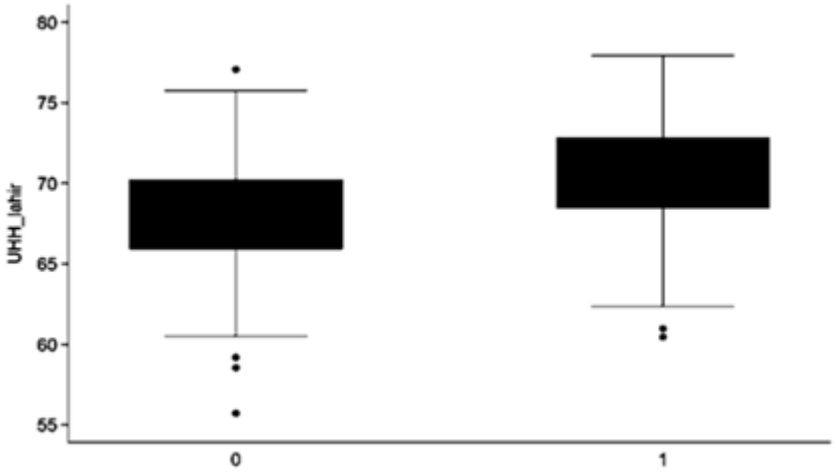
In addition to this form of rebellion, (Ng et al., 2007; Rahmawati, 2019) says that adolescents may consume cigarettes covertly in places that are not regulated in the KTR policy such as travelling to and from school and (Catalano & Gilleskie, 2021) says that peer effects increase when smokers gather so that smoking can be socially accepted and reinforced. In the age category of 41 years and above, namely in adult individuals, it was found that the existence of a Smoke Free Area (KTR) policy had a negative and significant effect of -0.34% with a significance level of 10%. These results indicate that local governments that have a Smoke Free Area policy can reduce the probability of individuals smoking in the adult age group.

According to (Tabuchi et al., 2014) one of the factors influencing the difference in the impact of Smoke Free Area policies on smoking prevalence in the adult age category with adolescents and young adults is the effectiveness of smoking bans is more effective in older people, because people are more likely to avoid unnecessary risks based on their accumulated experience of health risks during life. The different effects of the Smoke Free Area policy on the individual probability of smoking indicate that there are differences in individual views based on age group in responding to the implementation of the Smoke Free Area policy.

The effect of the Smoke Free Area policy on smoking prevalence in the adult age category with adolescents and young adults is different, the Smoke Free Area policy is important in order to improve the quality of health and to control the impact of cigarette consumption on health through controlling and limiting tobacco consumption. Research conducted by (Martini et al., 2022) shows that there is a significant relationship between a high percentage of smoking and a high prevalence of diseases caused by smoking, such as diabetes mellitus, hypertension and pulmonary tuberculosis in districts / cities in Indonesia.

In Indonesia, in measuring the quality of health, the Central Bureau of Statistics (BPS) uses the variable Life Expectancy at Birth (UHH) as a reference. In 2023 the average Life Expectancy at Birth in Indonesia will be 72.13 years, out of 71 districts/cities that do not have a Smoke Free Area Policy until 2023, only 10 districts/cities have a Life Expectancy at Birth that is higher than the national average. Therefore, all local governments, both provincial and district and city levels, must have a Smoke Free Area policy as an effort to improve the quality of life of the community through controlling and limiting cigarette consumption.

Figure 1 Relationship between Life Expectancy at Birth (UHH) and the Availability of KTR Policy



Based on the figure above, it can be seen that district and city governments that have a *Smoke Free Area* (KTR) policy tend to have a higher Life Expectancy at Birth (UHH) than those that do not. Local governments having a *Smoke Free Area* policy is important in improving the quality of health, but it is not enough because commitment, consistent law enforcement and regular monitoring are key factors in implementing the *Smoke Free Area* policy.

As stated by *(Martini et al., 2022)* that it is not only the addition of areas that have *Smoke Free Area* (KTR) *regulations but* implementing these regulations correctly that will effectively reduce the number of smokers and the diseases they cause. The strengthening and expansion of the *Smoke Free Area* policy, which aims to limit the scope of the community to smoke by prohibiting smoking activities in public places, is important to be implemented in all district and city governments in Indonesia in order to control the impact of cigarette consumption in Indonesia.

This is in line with the results of research conducted *(Rahajeng, 2016)* , which found that the factors that cause the success of the *Smoke Free Area* policy to reduce the proportion of smokers every day are local government commitment, consistent law enforcement and regular supervision and compliance of stakeholders involved in implementing the KTR policy.

The Effect of Length of Implementation of the Smoke Free Area Policy on Smoking Prevalence

The results of previous studies show that the longer the policy is implemented, the more significant the impact on reducing smoking prevalence, as stated by (Fong et al., 2006) that the implementation of a long-standing smoking ban contributes to a sustainable decline in smoking rates over time. Similar results were also shown by (Catalano & Gilleskie, 2021), a full or partial smoking ban had no significant impact on smoking prevalence in Argentina in the first year of implementation, but had a significant impact every year after the implementation of a full smoking ban, where the implementation of a smoking ban policy in public places significantly reduced smoking prevalence.

In this study, it was found that the effect of the duration of the Smoke Free Area policy on smoking prevalence varied among age groups. The length of time the Smoke Free Area policy has been in place has a significant effect on smoking prevalence, but a different effect was found in each age group. The age group of adolescents aged 10-18 years had a positive effect of 0.0058% with significance at the 1% level. The positive effect was also shown by the young adult age group aged 19-40 years at 0.0485% and significant at the 5% level (p=0.002). The estimation results show that the longer the Smoke Free Area policy is in effect, increases the probability of

individuals in the adolescent age group aged 10 -18 years to smoke by 0.0058% and 0.049% in the young adult age group aged 10 -18 years. The increase in probability in adolescents and young adults along with the increase in the duration of the implementation of the Smoke Free Area policy according to (Tabuchi et al., 2014) occurs because smoking is a form of rebellion against the rules.

A different effect was shown by the adult age group, i.e. individuals aged 41 years and above. Different from the adolescent and young adult age groups, the estimation results in the adult age group show that the effect of the duration of the Smoke Free Area policy on smoking prevalence has a negative and significant effect, amounting to -0.000334 with significance at the 5% level (p=0.036). Based on the estimation results, it can be said that the longer the Smoke Free Area policy is in effect, it can reduce the probability of individuals to smoke in the adult age group aged 41 years and over by 0.0058%, the estimation results are in line with research conducted by (Buonanno & Ranzani, 2013) where smoking participation in adult individuals falls. The effect of the duration of the Smoke Free Area policy on smoking prevalence in each age group showed varying results, these findings indicate that the implementation of the Smoke Free Area policy has not been successful in reducing smoking prevalence across all age groups. According to (Tabuchi et al., 2014), smoking prohibition is one component of a multicomponent effort to reduce tobacco use, so changes in smoking behavior cannot be made only by smoking prohibition.

As part of efforts to reduce tobacco use, there are challenges that must be faced in implementing the Smoke Free Area policy, (Wahyuti et al., 2019) said that there are 4 main challenges faced in implementing the Smoke Free Area policy, first the budget in enforcing the Smoke Free Area policy, second the lack of support and collaboration from non-governmental organizations, third the lack of public awareness and fourth the absence of examples given by community leaders. Commitment, consistent law enforcement and regular monitoring as well as community participation are a must so that the policy can have an impact so that efforts to control the impact of cigarette consumption as the purpose of the policy can be realized.

Socioeconomic Factors on Smoking Prevalence

The results of the estimation of socioeconomic and demographic factors show that one of the variables that most influence the probability of an individual to smoke is gender. Based on the estimation results, it was found that the male variable in all general categories had a positive and significant effect with a significance level at the 1% level (p = 0.000), this makes the male variable one of the variables with the greatest influence on the probability of individual smoking especially in young adults at 56.1% followed by adults at 49.2% and adolescents at 1.99%, so it can be said that being male increases the probability of smoking greater than being female, significantly men are more likely to be smokers than women.

These findings are in line with the results of research conducted by (Ra et al., 2022), where the prevalence of smoking is higher in men compared to women. This may also be due to social and cultural norms that tend to be more permissive of men in smoking, but also by gender stereotypes that associate smoking with masculinity or identical to male habits. Research conducted by (Nangoi & Daeli, 2023) shows that smoking is still often identified with men and masculinity. The position of individuals in the household also affects the probability of individual smoking, the estimation results show that the variable Head of Household (KRT) in all age categories has a positive and significant effect on the probability of individuals to smoke.

Although not as large as the gender variable but these results still show that being the Head of Household increases the probability of individuals to smoke compared to individuals who are not the Head of Household. The increased probability of smoking may be related to exposure to the social environment, work roles, social and economic pressures and responsibilities of living as a Head of Household that trigger stress, thus making smoking an escape. An individual's marital status also contributes to the probability of smoking across age

categories, but with different effects. Marital status for individuals in the adolescent and adult age categories has a positive and significant effect of 0.77% and 1.98% respectively, while in the adult category it has a negative and significant effect. Educational factors provide an interesting influence on the probability of individuals to smoke, all variables both variables of education intermediate and education-high in all age categories significantly affect the probability of individuals to smoke and almost all have a negative effect but there is a different effect on the variable of secondary education in the adolescent age group which has a positive effect. Based on this it can be said that individuals with higher levels of education have a reduced probability of smoking, this is in line with previous research conducted by (Chen et al., 2018) and (Hapsari et al., 2022) which shows that the higher the education the lower the probability of individuals to smoke. This shows that higher education can increase better awareness of the negative effects of smoking.

The estimation results on the employment status variable showed a positive and significant effect across all age categories, indicating that individuals who work have a greater probability of smoking than individuals who do not work. This factor may be related to social interaction in the workplace, especially in work environments with a high smoking culture. While in individuals with schooling status, it has a negative and significant effect so that individuals who are still in school tend to have a lower probability of smoking. The limited access of individuals who go to school to cigarettes or the environment of education that is strict against smoking culture is something that can affect the decrease in probability.

The health variable is the only variable of all socioeconomic and demographic factors that has an insignificant result, namely in the young adult age category, but in the adolescent and adult age categories, all of them are significant, although they have different effects. In the adult age category, the estimation results are in line with previous research, where health status has a negative and significant effect. This indicates that individuals with poor health status reduce the probability of smoking, because individuals with poor health status show higher awareness of the negative effects of smoking.

In economic factors, the variable lnexpenditure has a positive and significant effect across all age categories. Individual expenditure measured through the logarithm of expenditure has a positive relationship with the probability of smoking, every one unit increase in log expenditure increases the probability of individuals to smoke. This occurs because expenditure that should be allocated to nutritious food and protein is instead allocated to cigarette consumption, the financial burden caused by smoking will result in decreased consumption of other commodities.

Research conducted by (Amalia et al., 2022) shows that, households that consume cigarettes will have lower nutritional adequacy this is an implication of the negative impact of cigarette consumption on household protein and energy intake. The decrease in protein and energy intake due to cigarette consumption is faced by 20% of households in the lowest expenditure group. (Djutaharta et al., 2022) also says that due to income limitations, poorer households will face greater difficulties in meeting adequate amounts of protein and energy intake.

In addition to socioeconomic factors, demographic factors also influence the probability of individuals to smoke. In the city variable, the estimation results in this study show that individuals living in urban areas have a lower probability of smoking than individuals living in rural areas across all age categories. The lower probability of individuals living in urban areas to smoke occurs because urban environments provide better access to health information or have stricter regulations on smoking restrictions.

The Java Island dummy variables all showed significant results, but in the adolescent age category, the probability of individuals living in Java Island to smoke increased by 0.2%, but in the young adult and adult age categories the probability of individuals to smoke decreased. In general, it can be said that the probability of individuals living in Java to smoke is lower than those living outside Java. This factor may be influenced by cultural differences and stricter

smoking ban policies in Java as well as better access to health information or stricter implementation of regulations. Demographic factors, namely the variable percentage_smoking_kabkota showed a positive and significant trend and was the variable with the largest effect on individual smoking probability across all age categories, namely by 3.4% in adolescents, 81.6% in young adults and 102.9% in the adult age category. This suggests that the influence of social and environmental norms has a strong impact on an individual's probability of smoking.

DISCUSSION

The purpose of this study was to analyze the effect of smoke-free area policies on individual smoking prevalence in Indonesia. The model developed successfully answered the main objective of this study, namely that the presence or absence of Smoke-Free Area policies has varying effects on individual smoking prevalence across different age groups. These results are consistent with studies conducted by (Buddelmeyer & Wilkins, 2021; Tabuchi et al., 2014), which found that smoking bans increase the probability of quitting smoking but do not apply to all age groups. According to (Tabuchi et al., 2014), this occurs because people are more likely to avoid unnecessary risks based on their experiences. Meanwhile, the duration of the implementation of the Smoke Free Area policy also showed varying results across age groups, indicating that the duration of the policy has not been successful in reducing smoking prevalence across all age groups.

Interestingly, these findings also show that the significance of the influence of Smoke Free Area policies on smoking prevalence is not only influenced by the existence of policies and their duration but also by more complex structural dimensions. Therefore, the results of this study not only highlight the influence of the policy but also consider other factors such as individual demographic characteristics and broader socio-economic contexts, as well as how individuals respond to the policy based on their age category.

CONCLUSION

The test results show that the presence or absence of a Smoke Free Area policy has varying effects on the prevalence of smoking among individuals in different age groups. In the adolescent and young adult age groups, it was found that the presence or absence of a Smoke Free Area policy had no significant effect on the probability of smoking but had a positive effect that could increase the probability of individuals to smoke although the effect was small, while in the adult age category the policy had a negative and significant effect on the probability of individuals to smoke.

The duration of the Smoke Free Area policy also showed varying results, but all were significant to the probability of individuals smoking in all age categories. In the teenage and young age categories the longer the policy is in effect has an impact on increasing the probability of individuals to smoke but in the adult age category the length of the policy decreases the probability of individuals to smoke.

Although the impact is small, the Smoke Free Area Policy is important for the Government to control the impact of cigarette consumption on health. These varied results indicate that the Smoke Free Area policy has not been effectively implemented, therefore, all local governments both at the provincial and district/city levels should have a Smoke Free Area policy as an effort to improve the quality of health and to control the impact of cigarette consumption on health by controlling and limiting tobacco consumption. The purpose of the establishment of the *Smoke Free Area* policy in Indonesia is to realize effective and efficient control of the impact of cigarette consumption in Indonesia. In order to realize this, the Government needs to do so:

1. Encourage all local governments, both at the provincial and district/city levels, to have regulations in the form of Regional Regulations and Regional Head Regulations regarding Smoke Free Areas.
2. Local governments that already have a Smoke Free Area policy should be able to increase consistency in the implementation and supervision of Smoke Free Area regulations, not only when the policy is newly established but must always increase supervision consistently, especially in local governments with high smoking prevalence rates.
3. Cross-sectoral collaboration between the Government, non-governmental organizations and the community in socializing the dangers of smoking and the benefits of Smoke Free Areas in a sustainable manner to all levels of society.

LIMITATION

The study has limitations in terms of data and testing, as well as the potential for endogeneity. This study did not include types of smoke-free area policies based on policy coverage categories and compliance with smoke-free area policies at the local government level, as well as the intensity of individual smoking. These limitations may potentially weaken or amplify the actual effects of smoke-free area policies on smoking prevalence. However, the consistency of the results indicates that these findings are robust and can serve as a valuable foundation for future empirical research and policy development.

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