



Determinants of Smoking Behavior in The Special Region of Yogyakarta: An Analysis Of 2024 Susenas Data

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Abstract

Smoking remains a major public health and socioeconomic concern in Indonesia, including the Special Region of Yogyakarta. This study examined demographic, socioeconomic, and residential determinants of smoking behavior among residents aged 15 years and older using March 2024 National Socioeconomic Survey (Susenas) data. A quantitative descriptive-analytical design was applied to 10,729 respondents, and smoking status was analyzed using Probit regression with marginal effects. The results showed that age and education were negatively associated with smoking, while gender, marital status, employment status, and urban residence were positively associated with smoking probability. Welfare also showed a negative relationship and was significant at the 10% level. Gender had the largest marginal effect, with men having a 48.93 percentage-point higher probability of smoking than women. The Likelihood Ratio test confirmed that the explanatory variables were jointly significant, while the Pseudo R-squared value of 0.3726 indicated meaningful model performance. These findings support targeted tobacco-control strategies focused on younger populations, men, lower-educated groups, workers, economically vulnerable households, and urban communities. Integrated prevention, cessation support, workplace regulation, and accessible health education are essential for reducing smoking disparities.

Keywords: *demographic determinants, Probit model, smoking behavior, socioeconomic factors, tobacco control.*



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INTRODUCTION

Smoking remains a major public health challenge because tobacco consumption contributes substantially to preventable morbidity, premature mortality, and long-term socioeconomic losses. Globally, tobacco use continues to affect a large population, with the burden disproportionately concentrated among men and populations exposed to persistent social and economic vulnerabilities (World Health Organization, 2024; World Health Organization, 2025). In Indonesia, tobacco consumption remains particularly concerning because approximately 70.2 million adults use tobacco products, while smoking prevalence is substantially higher among men than among women (Kementerian Kesehatan Republik Indonesia & World Health Organization, 2021). Tobacco use also begins at relatively young ages, as demonstrated by the continued presence of smoking among adolescents and school-aged populations in Indonesia (World Health Organization, 2021).

The health consequences of smoking extend beyond individual behavior because tobacco exposure is strongly associated with cardiovascular disease, chronic respiratory disorders, various forms of cancer, and premature death. The Global Burden of Disease Study identified tobacco smoking as an important contributor to mortality and disability across countries and demographic groups, illustrating the broad consequences of sustained tobacco consumption (GBD 2019 Tobacco Collaborators, 2021). The World Health Organization has similarly emphasized that tobacco use remains one of the major modifiable risk factors for non-communicable diseases and avoidable mortality worldwide (World Health Organization, 2023; World Health Organization, 2024c). These health consequences generate additional social costs because smoking-related illness can reduce household productivity, increase medical expenditure, and weaken economic welfare.

The economic implications of smoking are especially relevant in Indonesia, where household expenditure on cigarettes can compete with spending on food, education, housing, and healthcare. Household consumption patterns indicate that tobacco products continue to occupy a significant position within the expenditure structure of many Indonesian households, including those with limited economic resources (Badan Pusat Statistik, 2023). Smoking may therefore create a double burden for low-income households because it simultaneously absorbs disposable income and increases the probability of future health expenditure. This condition is particularly important because socioeconomic inequality in smoking behavior has widened over time, with disadvantaged groups often facing a disproportionately high burden of tobacco consumption and its consequences (Nugraheni et al., 2025).

From an economic perspective, smoking behavior can be understood as a consumption decision influenced by individual preferences, income, prices, information, social environment, and the addictive characteristics of nicotine. Consumer behavior theory explains that individuals allocate limited resources among alternative goods and services in an effort to maximize utility under budget constraints (Sukirno, 2005; Setiadi, 2019). In the context of addictive goods, current consumption decisions may also depend on previous consumption because repeated tobacco use can alter future preferences and strengthen continued demand (Chaloupka & Warner, 2000). This mechanism indicates that smoking cannot be explained solely by short-term preferences but should also be examined through demographic, socioeconomic, and behavioral characteristics that influence individual consumption choices.

Empirical studies in Indonesia have consistently shown that smoking behavior is associated with multiple demographic and socioeconomic characteristics rather than a single determinant. Education, employment status, age, gender, marital status, economic conditions, and place of residence have been identified as important correlates of smoking participation in different Indonesian populations (Hapsari et al., 2022; Nugraheni et al., 2025). Lower educational attainment is frequently associated with a greater likelihood of smoking because limited health literacy may reduce awareness of long-term health risks and weaken responses to tobacco-control information. Socioeconomic differences may also influence smoking through purchasing power, workplace culture, exposure to tobacco promotion, and unequal access to preventive health information.

Gender represents one of the most prominent demographic dimensions of smoking behavior in Indonesia because tobacco use is strongly concentrated among men. National tobacco surveillance has repeatedly documented a substantial gap between male and female smoking prevalence, suggesting that gender-related social norms and behavioral patterns play an important role in smoking participation (Kementerian Kesehatan Republik Indonesia & World Health Organization, 2021). Age may also influence smoking behavior because initiation often occurs during adolescence or early adulthood, while cessation patterns can change as individuals become older and increasingly concerned about health risks. These patterns indicate that demographic characteristics should be examined simultaneously to identify population groups with the greatest probability of smoking and the strongest need for targeted intervention.

The Special Region of Yogyakarta provides an important setting for examining these determinants because the province combines relatively high human development with persistent tobacco consumption across its districts and municipalities. The province recorded a Human Development Index of 81.62 in 2024, indicating relatively favorable achievements in education, health, and living standards (Badan Pusat Statistik Provinsi Daerah Istimewa Yogyakarta, 2024a). Nevertheless, household survey statistics indicate that cigarette consumption remains substantial, demonstrating that improvements in aggregate human development do not automatically eliminate tobacco-related behavior (Badan Pusat Statistik Provinsi Daerah Istimewa Yogyakarta, 2024b). Local evidence also shows that smoking among young people in Yogyakarta is shaped by social environments, family roles, school regulations, and other contextual influences (Wibowo & Trisnowati, 2024; Widiyaningsih et al., 2024; Yuningrum & Trisnowati, 2024).

Although previous studies have examined smoking determinants in Indonesia, updated province-specific evidence using the 2024 National Socioeconomic Survey remains important for understanding recent behavioral patterns in the Special Region of Yogyakarta. This study therefore analyzes smoking behavior among residents aged 15 years and older using Susenas March 2024 data and focuses on age, gender, education, marital status, employment, welfare, and place of residence as

explanatory variables. A Probit regression model is employed because smoking status is represented as a binary outcome, while marginal effects are used to estimate the magnitude of changes in smoking probability associated with each determinant (Gujarati & Porter, 2009). The findings are expected to provide empirical evidence for the development of more targeted tobacco-control policies by identifying demographic and socioeconomic groups with different probabilities of smoking in the Special Region of Yogyakarta.

RESEARCH METHODS

This study employed a quantitative descriptive-analytical approach to examine demographic, socioeconomic, and residential factors associated with smoking behavior among individuals aged 15 years and older in the Special Region of Yogyakarta. The analysis used secondary data from the March 2024 National Socioeconomic Survey (Susenas), consisting of the KOR and KP datasets provided by Statistics Indonesia. The initial dataset contained 13,158 individuals, and after applying eligibility criteria based on age and data completeness, 10,729 respondents were included in the final analysis. The dependent variable was smoking status, categorized as smoker or non-smoker, while the independent variables consisted of age, gender, education, marital status, employment status, welfare level, and place of residence.

Data analysis was conducted using descriptive statistics and Probit regression estimated through the Maximum Likelihood method because the dependent variable was binary. The statistical significance of individual coefficients was assessed using the Z-test, while the simultaneous significance of the model was evaluated using the Likelihood Ratio test. Model fit was assessed using Pseudo R-squared, and marginal effects were calculated to estimate the change in the probability of smoking associated with each explanatory variable, allowing the regression results to be interpreted in probability terms (Gujarati & Porter, 2009). All data processing and statistical estimations were performed using Stata version 14.

RESULTS AND DISCUSSION

Demographic Determinants of Smoking Behavior: Age, Gender, and Education

The Probit estimation indicates that demographic characteristics constitute important determinants of smoking behavior among residents aged 15 years and older in the Special Region of Yogyakarta. Age, gender, and education were statistically significant at the 1% level, demonstrating that differences in demographic profiles are systematically associated with variations in smoking probability. Age and education exhibited negative coefficients, whereas gender showed a strong positive association with smoking participation. These findings reinforce the argument that tobacco consumption should be understood not only as an individual preference but also as behavior embedded within demographic and social structures (Hapsari et al., 2022; Nugraheni et al., 2025).

Age had a negative and statistically significant relationship with smoking behavior, with a Probit coefficient of -0.0034739 and a probability value of 0.004. The marginal effect of -0.0007057 indicates that each additional year of age was associated with an approximately 0.07% decrease in the probability of smoking, holding the other explanatory variables constant. This pattern suggests that smoking participation is relatively more concentrated among younger individuals within the population analyzed. Previous evidence has similarly emphasized that tobacco initiation frequently develops during adolescence or early adulthood, when individuals may be particularly susceptible to peer influence, experimentation, advertising, and social acceptance of smoking (World Health Organization, 2021; Nurhalimah et al., 2023).

The negative association between age and smoking probability may also reflect differences in risk perception across the life course. Older individuals are generally more likely to have accumulated direct or indirect experiences with smoking-related illness, potentially increasing awareness of cardiovascular, respiratory, and other long-term health consequences associated with tobacco use. Tobacco consumption is a major contributor to preventable mortality and disability, and the health burden becomes increasingly visible as individuals age (GBD 2019 Tobacco Collaborators, 2021). Consequently, the lower probability of smoking among older respondents may partly represent cessation behavior or a stronger preference for health preservation as perceived health risks become more immediate.

The age pattern observed in Yogyakarta should nevertheless be interpreted within the broader context of tobacco-use initiation and persistence. Smoking is an addictive consumption behavior in which previous consumption can influence present demand, making early initiation particularly relevant to future smoking trajectories (Chaloupka & Warner, 2000). From an economic perspective, addictive consumption creates intertemporal dependence because the utility derived from current smoking may be influenced by accumulated consumption experiences and nicotine dependence. Therefore, preventive interventions targeting younger populations can have longer-term implications by reducing the likelihood that experimentation develops into persistent tobacco consumption.

Gender emerged as the most influential demographic determinant in the model, with a Probit coefficient of 2.408668 and a probability value below 0.001. The estimated marginal effect of 0.4892797 indicates that male respondents had a smoking probability approximately 48.93 percentage points higher than female respondents, after controlling for other characteristics. This magnitude was substantially larger than the marginal effects of all other variables included in the model, indicating a pronounced gender disparity in tobacco consumption in the Special Region of Yogyakarta. National tobacco surveillance has likewise demonstrated that smoking prevalence among Indonesian men is dramatically higher than among women, making gender one of the most persistent dimensions of tobacco inequality in the country (Kementerian Kesehatan Republik Indonesia & World Health Organization, 2021).

Table 1. Probit Estimates and Marginal Effects of Demographic Determinants of Smoking Behavior

Variable	Probit Coefficient	Std. Error	p-value	Marginal Effect (dy/dx)	Direction
Age	-0.0034739	0.0011976	0.004	-0.0007057	Negative
Male gender	2.4086680	0.0559332	<0.001	0.4892797	Positive
Education	-0.1736394	0.0193025	<0.001	-0.0352719	Negative

Source: March 2024 Susenas data, processed by the authors.

The substantial gender difference is consistent with the social normalization of smoking among men in Indonesia. Tobacco use among men may be reinforced by peer networks, workplace interaction, masculine social norms, and the relatively greater cultural acceptability of male smoking compared with female smoking. National and international evidence indicates that tobacco use in Indonesia remains heavily concentrated among men, while female smoking prevalence remains comparatively low (World Health Organization, 2024a; World Health Organization, 2024c). The result therefore suggests that gender-sensitive tobacco-control programs are necessary because interventions designed without accounting for this disparity may not adequately reach the population group responsible for the largest share of smoking participation.

Education also demonstrated a negative and statistically significant association with smoking behavior, with a Probit coefficient of -0.1736394 and a probability value below 0.001. Its marginal effect of -0.0352719 indicates that movement to a higher educational category was associated with an approximately 3.53 percentage-point reduction in smoking probability, other variables being held constant. This relationship suggests that educational attainment may operate as a protective socioeconomic resource against tobacco consumption. Hapsari et al. (2022) similarly found that socioeconomic characteristics, including education, were associated with smoking habits in Indonesia, while Nugraheni et al. (2025) documented persistent socioeconomic inequalities in smoking status over time.

Higher education can reduce smoking probability through several mechanisms, particularly greater health literacy, improved ability to interpret risk information, and stronger access to preventive knowledge. Individuals with more education may be better positioned to understand the cumulative risks of nicotine addiction, cardiovascular disease, respiratory disorders, and premature mortality associated with tobacco consumption (World Health Organization, 2023; World Health Organization, 2024c). Education may also strengthen individuals' capacity to evaluate persuasive advertising and distinguish short-term perceived benefits from long-term health and economic costs. From the perspective of consumer behavior, greater access to information can modify preferences and

purchasing decisions by changing how consumers assess the expected utility and risks of a product (Setiadi, 2019).

The educational gradient in smoking also carries an important socioeconomic dimension because lower educational attainment frequently overlaps with more limited employment opportunities and constrained household resources. Cigarette expenditure among economically vulnerable households can divert income from essential goods and services, including food, healthcare, housing, and education, thereby intensifying welfare losses associated with smoking (Badan Pusat Statistik, 2023). Nugraheni et al. (2025) further demonstrate that socioeconomic inequality in Indonesian smoking behavior has widened over time, emphasizing that tobacco consumption increasingly reflects broader patterns of social disadvantage. These results imply that tobacco-control communication should not rely exclusively on generalized health warnings but should also adopt communication strategies that are understandable and accessible to groups with lower educational attainment.

Taken together, age, gender, and education reveal a distinct demographic profile of smoking behavior in the Special Region of Yogyakarta. Younger individuals, men, and respondents with lower educational attainment exhibited comparatively higher probabilities of smoking, although the magnitude of association varied considerably across these determinants. The particularly large marginal effect associated with gender demonstrates that male smoking should remain a central target of intervention, while age and education indicate the importance of early prevention and accessible health education. These results are also consistent with local evidence showing that smoking among young populations in Yogyakarta is influenced by social environments, family roles, and preventive regulations (Wibowo & Trisnowati, 2024; Widiyaningsih et al., 2024; Yuningrum & Trisnowati, 2024).

The findings have practical implications for designing more differentiated tobacco-control strategies in Yogyakarta. Prevention programs should prioritize adolescents and young adults before smoking behavior becomes established, while male-focused interventions can be integrated into workplaces, educational institutions, community organizations, and other environments where smoking is socially reinforced. Educational strategies should additionally be adapted to different literacy levels so that information concerning addiction, disease risk, and household economic consequences can be effectively understood by populations with lower educational attainment. By combining age-specific prevention, gender-sensitive interventions, and education-oriented risk communication, tobacco-control policies may respond more precisely to the demographic determinants identified in the 2024 Susenas analysis (World Health Organization, 2024d; World Health Organization, 2025).

Socioeconomic Determinants of Smoking Behavior: Marital Status, Employment, and Welfare

The socioeconomic dimension of smoking behavior in the Special Region of Yogyakarta is reflected in the significant associations of marital status, employment status, and welfare with smoking participation. The Probit model shows that marital status and employment status have positive and statistically significant relationships with smoking behavior, whereas welfare has a negative relationship that is statistically significant at the 10% level. These findings indicate that smoking is closely connected with household responsibilities, labor-market participation, and economic capacity rather than being determined exclusively by demographic characteristics. From a consumer-behavior perspective, individual consumption decisions are influenced by income, social position, household conditions, and the environment in which consumption takes place (Setiadi, 2019; Sugiharsono & Wahyuni, 2019).

Marital status had a positive and statistically significant association with smoking behavior, with a Probit coefficient of 0.1358019 and a probability value of 0.001. The marginal effect of 0.0275858 indicates that married respondents had an approximately 2.76 percentage-point higher probability of smoking than respondents in the reference marital-status category, holding other factors constant. This result suggests that marital transition and household responsibilities may be associated with changes in behavioral patterns and consumption preferences. Economic responsibilities, work demands, and social interaction within married adulthood may influence tobacco consumption as part of stress-coping practices or established daily routines.

The relationship between marital status and smoking should not be interpreted simply as a direct causal effect of marriage itself. Marriage may reflect a broader stage of adulthood in which individuals are more likely to participate in the labor market, manage household expenditure, and interact within social environments where smoking has become normalized. Consumer decisions are often shaped by household structure, social expectations, and personal motives, which can alter the allocation of income across different categories of consumption (Utami, 2017; Setiadi, 2019). Consequently, the positive marital-status coefficient may capture a combination of socioeconomic circumstances and behavioral patterns associated with married life.

Employment status also demonstrated a positive and statistically significant relationship with smoking behavior, with a Probit coefficient of 0.2598566 and a probability value below 0.001. The marginal effect of 0.0527854 indicates that respondents classified as workers had a smoking probability approximately 5.28 percentage points higher than those in the reference employment category. This association may reflect the greater availability of disposable income among employed individuals as well as exposure to workplace environments in which smoking may function as a social activity. Previous Indonesian research has shown that employment and socioeconomic conditions are important factors associated with smoking behavior (Hapsari et al., 2022; Gai & Tjahjono, 2021).

Employment can influence tobacco consumption through both economic and social mechanisms. Regular income increases purchasing capacity and may reduce the immediate budget constraint associated with cigarette expenditure, particularly when tobacco products remain readily available. At the same time, workplace culture, occupational stress, peer interaction, and routine smoking breaks may reinforce continued tobacco consumption among workers. From a microeconomic perspective, changes in income affect consumer purchasing possibilities and can modify demand for normal or habitual goods depending on individual preferences and price sensitivity (Ansar, 2017; Rahardja & Manurung, 2010).

Table 2. Probit Estimates and Marginal Effects of Socioeconomic Determinants of Smoking Behavior

Variable	Probit Coefficient	Std. Error	p-value	Marginal (dy/dx)	Effect	Direction
Marital status	0.1358019	0.0408290	0.001	0.0275858		Positive
Employment status	0.2598566	0.0362105	<0.001	0.0527854		Positive
Welfare	-1.64×10^{-8}	9.65 10^{-9}	$\times$ 0.089	-3.34×10^{-9}		Negative

Source: March 2024 Susenas data, processed by the authors.

The positive employment effect is also relevant from the perspective of productivity and labor economics. Smoking may create short-term perceived benefits, such as stress relief or social interaction, but can simultaneously generate longer-term productivity losses through illness, absenteeism, and reduced physical capacity. Gai and Tjahjono (2021) highlight the relationship between smoking behavior and labor productivity in Indonesia, emphasizing that tobacco use can have consequences that extend beyond individual consumption. This creates an economic paradox in which employment may increase the capacity to purchase cigarettes while smoking itself can undermine future productivity and health.

Welfare showed a negative relationship with smoking behavior, with a Probit coefficient of -1.64×10^{-8} and a probability value of 0.089. Although the magnitude of the marginal effect was very small, the direction suggests that higher welfare levels were associated with a lower probability of smoking. This finding is consistent with broader evidence showing that smoking prevalence is frequently concentrated among socioeconomically disadvantaged populations, even though income can simultaneously increase purchasing power for tobacco products (Nugraheni et al., 2025). The relationship between welfare and smoking is therefore complex because economic resources can influence both the affordability of cigarettes and access to health information, education, and preventive services.

The negative welfare gradient can also be interpreted within the framework of household expenditure allocation. Households with limited resources face stronger trade-offs between tobacco expenditure and essential consumption, meaning cigarette spending can crowd out expenditure on food, education, healthcare, and other welfare-enhancing goods. Statistics Indonesia has documented household consumption patterns that demonstrate the continuing significance of cigarette expenditure within Indonesian household budgets (Badan Pusat Statistik, 2023). This pattern is important because persistent tobacco consumption among lower-welfare households may reinforce economic vulnerability by diverting scarce resources toward an addictive product.

The observed welfare relationship should nevertheless be interpreted cautiously because the estimated effect is statistically weaker than the effects of marital status and employment. Differences in smoking behavior across welfare groups may depend on the specific type of tobacco product, social context, education, and geographic exposure to tobacco markets. Elsa and Nadjib (2019), for example, found that socioeconomic characteristics were associated with electronic-cigarette use in Indonesia, illustrating that the relationship between economic status and tobacco consumption may differ across products. The growing presence of electronic cigarettes further complicates the socioeconomic landscape of tobacco use because newer products may attract different consumer groups and involve different price and marketing structures (World Health Organization, 2024b; GoodStats, 2025).

Taken together, marital status, employment, and welfare demonstrate that smoking behavior in Yogyakarta is embedded in the socioeconomic organization of daily life. Married and employed respondents had higher probabilities of smoking, while greater welfare was associated with a slightly lower probability, suggesting that income capacity alone does not fully explain tobacco consumption. Household roles, work environments, education, health awareness, and expenditure priorities likely interact to shape whether individuals begin, maintain, or reduce smoking behavior. These findings support the broader argument that tobacco use reflects a combination of individual choice and structural socioeconomic conditions rather than a purely personal lifestyle decision (Chaloupka & Warner, 2000; Mankiw, 2021).

The policy implications of these findings require a combination of workplace-based, household-based, and economically targeted interventions. Workplaces can strengthen smoke-free regulations, provide cessation assistance, and integrate tobacco-risk education into occupational health programs, while family-oriented interventions can encourage household members to support cessation and reduce exposure to second-hand smoke. Lower-welfare populations may require more accessible health communication and stronger protection from the economic burden created by tobacco expenditure, especially where cigarette consumption competes with essential household needs. Tobacco-control strategies that combine behavioral education, workplace regulation, fiscal measures, and socioeconomic targeting are therefore more likely to address the multiple pathways through which marital status, employment, and welfare influence smoking behavior (Kementerian Kesehatan Republik Indonesia, 2020; World Health Organization, 2025).

Residential Context, Model Performance, and Tobacco-Control Implications

Place of residence was statistically associated with smoking behavior among residents aged 15 years and older in the Special Region of Yogyakarta. The Probit coefficient for urban residence was 0.0741251 with a probability value of 0.044, indicating a positive and statistically significant association at the 5% level. The marginal effect of 0.0150572 indicates that urban residents had an approximately 1.51 percentage-point higher probability of smoking than rural residents, after controlling for demographic and socioeconomic characteristics. This result demonstrates that residential context remains relevant to tobacco consumption even within a province characterized by relatively high human development (Badan Pusat Statistik Provinsi Daerah Istimewa Yogyakarta, 2024a; Badan Pusat Statistik Provinsi Daerah Istimewa Yogyakarta, 2024b).

The higher smoking probability among urban respondents may reflect the greater intensity of economic activity, product availability, commercial exposure, and social interaction in urban settings. Urban consumers generally encounter denser retail networks and broader market access, which can reduce the practical barriers to purchasing tobacco products. Consumer behavior theory suggests that availability, price, income, and environmental exposure influence individual purchasing decisions and patterns of consumption (Sudarman, 2014; Sjaroni et al., 2019). The result therefore supports the view

that smoking is influenced not only by individual preferences but also by the environments in which tobacco products are marketed, purchased, and socially consumed.

Urban environments may additionally expose individuals to diverse forms of tobacco promotion and newer nicotine products. Electronic cigarettes and other emerging tobacco products have expanded the range of nicotine consumption options available to consumers, especially within commercially active areas and digitally connected populations (World Health Organization, 2024b). Indonesian evidence also suggests that socioeconomic and residential characteristics can differentiate patterns of conventional and electronic cigarette consumption (Elsa & Nadjib, 2019). Consequently, tobacco-control programs in urban areas must account for both conventional cigarettes and newer nicotine products rather than treating tobacco use as a homogeneous behavioral phenomenon.

The residential effect found in this study should nevertheless be interpreted in relation to local social conditions in Yogyakarta. Previous studies in Yogyakarta have shown that smoking behavior among younger populations is affected by family supervision, school regulations, peer environments, and social exposure (Wibowo & Trisnowati, 2024; Widiyaningsih et al., 2024). Yuningrum and Trisnowati (2024) similarly demonstrated that conventional cigarette use among school children in Yogyakarta is related to multiple behavioral and environmental determinants. These findings indicate that geographic residence may capture broader differences in social norms, accessibility, institutional control, and community environments rather than geographic location alone.

The residential finding is also relevant when considered alongside regional socioeconomic disparities. Although the Special Region of Yogyakarta recorded a relatively high Human Development Index, differences in welfare, consumption capacity, and access to resources remain present across population groups (Badan Pusat Statistik Provinsi Daerah Istimewa Yogyakarta, 2024a). Poverty and household expenditure conditions can modify tobacco consumption by influencing both purchasing power and competition between cigarettes and essential household needs (Badan Pusat Statistik, 2024b). Accordingly, the effect of urban residence should be interpreted together with the welfare, education, and employment dimensions identified in the model rather than as an isolated geographic phenomenon.

Table 3. Overall Probit Model Performance and Residential Effect

Indicator		Estimate	Statistical Result	Interpretation
Urban residence coefficient		0.0741251	p = 0.044	Positive and significant at 5%
Urban residence marginal effect		0.0150572	p = 0.044	Urban probability higher by approximately 1.51 percentage points
Likelihood Ratio Chi-square	Ratio	4556.12	p < 0.001	Independent variables jointly significant
Number of observations	of	10,729	—	Final analytical sample
Pseudo R-squared		0.3726	—	Model provides substantial explanatory information for a binary-response specification

Source: March 2024 Susenas data, processed by the authors.

The overall statistical performance of the model confirms that the explanatory variables jointly contribute to distinguishing smoking from non-smoking behavior. The Likelihood Ratio statistic was 4,556.12 with a probability below 0.001, indicating that the Probit model containing age, gender, education, marital status, employment, welfare, and residence performed significantly better than a model without these predictors. This joint significance is important because smoking behavior is unlikely to be explained adequately through a single demographic or socioeconomic characteristic. Probit estimation is appropriate for binary dependent variables and allows the probability of an event to be modeled as a function of multiple explanatory factors (Gujarati & Porter, 2009; Widiyanto, 2013).

The model produced a Pseudo R-squared value of 0.3726, which indicates meaningful explanatory performance within a binary-response framework but should not be interpreted identically

to the ordinary R-squared used in linear regression. The remaining unexplained variation may reflect behavioral, cultural, psychological, household, policy, or environmental characteristics that were not available in the Susenas variables employed in this study. Smoking decisions can involve preferences, past consumption, perceived utility, social influence, and addictive reinforcement, all of which may extend beyond standard socioeconomic indicators (Yusinta, 2010; Chaloupka & Warner, 2000). Future studies could therefore incorporate tobacco prices, peer smoking, household smoking exposure, advertising exposure, psychosocial conditions, nicotine dependence, and cessation intentions where suitable data are available.

The pattern of findings also reinforces the economic interpretation of tobacco consumption as a decision made under constraints but influenced by addiction and social context. Traditional microeconomic theory emphasizes that consumers allocate income across alternative goods according to preferences, prices, and available resources (Mankiw, 2006; Ansar, 2017). Tobacco consumption differs from many ordinary consumer goods because previous consumption may reinforce future demand through dependence, making current decisions partly conditional on past behavior. This characteristic helps explain why information about health consequences alone may be insufficient to change smoking behavior, particularly once nicotine dependence has become established.

The findings have important public-health implications because tobacco consumption remains associated with substantial disease and mortality burdens. National health surveys continue to identify tobacco use as a major behavioral risk factor in Indonesia, while cardiovascular and other smoking-related conditions create long-term pressure on individuals, households, and the healthcare system (Kementerian Kesehatan Republik Indonesia, 2019; Kementerian Kesehatan Republik Indonesia, 2023). Recent evidence also links smoking behavior with hypertension among young adults, demonstrating that adverse consequences can emerge before old age (Ramadhan et al., 2026). Tobacco-control interventions should therefore combine prevention of initiation, cessation support, protection from second-hand smoke, and reduction of environmental exposure to tobacco products.

Policy responses should also consider the economic and cultural embeddedness of cigarettes in Indonesia. Cigarettes have historically occupied a visible position in Indonesian consumption and social practices, which can complicate efforts to reduce tobacco demand solely through individual-level health messages (Wibisono, 2014). National statistics showing continued smoking among people aged 15 years and older further demonstrate that tobacco use remains a persistent population-level issue (Badan Pusat Statistik, 2024a). Effective policy consequently requires coordinated measures involving taxation, smoke-free environments, restrictions on advertising and product access, cessation services, public education, and targeted interventions for groups identified as having higher smoking probabilities.

Overall, the 2024 Susenas analysis demonstrates that smoking behavior in the Special Region of Yogyakarta is jointly structured by demographic, socioeconomic, and residential characteristics. Gender produced the largest marginal effect, while age, education, marital status, employment, welfare, and urban residence contributed additional differences in smoking probability, confirming that tobacco consumption is multidimensional rather than attributable to a single determinant. These findings support tobacco-control strategies that differentiate interventions by population characteristics while remaining consistent with broader national and international efforts to reduce tobacco-related disease and economic burden (World Health Organization, 2024d; World Health Organization, 2025). Strengthening prevention among younger people, targeting male smokers, improving accessible health education, expanding workplace cessation initiatives, protecting economically vulnerable households, and reinforcing urban tobacco-control measures can provide a more context-sensitive response to smoking behavior in Yogyakarta.

CONCLUSION

This study demonstrates that smoking behavior among residents aged 15 years and older in the Special Region of Yogyakarta is significantly associated with demographic, socioeconomic, and residential characteristics. Age and education were negatively associated with smoking probability, whereas gender, marital status, employment status, and urban residence showed positive associations. Welfare also had a negative relationship with smoking behavior, although its statistical significance was weaker than that of the other determinants. Among all explanatory variables, gender produced the largest marginal effect, with men having a 48.93 percentage-point higher probability of smoking than

women, indicating that gender differences constitute the most prominent pattern of smoking behavior in the study population.

The overall Probit model was statistically significant, as demonstrated by the Likelihood Ratio statistic of 4,556.12 with a probability below 0.001, while the Pseudo R-squared value of 0.3726 indicated meaningful explanatory performance for the binary-response specification. These findings suggest that tobacco-control policies in Yogyakarta should adopt differentiated strategies targeting younger individuals, men, people with lower educational attainment, workers, economically vulnerable households, and urban populations. Preventive education should be strengthened before smoking becomes established, while cessation support, workplace smoke-free policies, family involvement, and accessible risk communication should be expanded. Combining demographic targeting with socioeconomic and residential interventions may provide a more comprehensive approach to reducing smoking prevalence and its associated health and economic burdens.

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