



Socioeconomic and cognitive determinants of smoking behavior in Indonesia: Analysis of GATS 2021

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ABSTRACT

Background: Tobacco use remains a major public health challenge in Indonesia. This study addresses an important research gap by examining the interaction between structural determinants and cognitive-environmental reinforcements, which previous studies have largely investigated separately. By integrating the social determinants of health (SDH) and social cognitive theory (SCT) frameworks, this study examines the knowledge-behavior gap using nationally representative data from the 2021 global adult tobacco Survey (GATS) Indonesia. **Methods:** A cross-sectional analysis was conducted on 9,141 respondents aged ≥ 15 years. Survey-weighted multivariable logistic regression was performed to estimate adjusted odds ratios (AORs) and 95% confidence intervals (CIs), accounting for the complex multistage sampling design using the `svy` command in Stata 17.0. **Findings:** Sex was the strongest predictor of smoking; females were significantly less likely to smoke than males (AOR = 0.013; 95% CI = 0.009–0.018; $p < 0.001$). Higher education (AOR = 0.529) and older age (≥ 65 years; AOR = 0.419) were protective factors ($p < 0.001$). Exposure to tobacco promotion increased smoking likelihood (AOR = 1.249; $p = 0.017$). While awareness of conventional smoking risks was strongly protective (AOR = 0.367; $p < 0.001$), knowledge of e-cigarette health risks was not significantly associated with smoking status ($p = 0.380$), revealing a knowledge-behavior gap. **Conclusion:** Smoking behavior in Indonesia is shaped by gender norms, socioeconomic inequalities, and cognitive influences reinforced by tobacco promotion. Tobacco control strategies should extend beyond conventional risk education to address cognitive and environmental factors driving smoking behavior. **Novelty/Originality of this article:** This study is the first to integrate SDH and SCT using nationally representative GATS Indonesia 2021 data to jointly examine structural and cognitive determinants of smoking. It demonstrates that awareness of e-cigarette health risks does not necessarily translate into lower smoking, providing new evidence for more targeted and theory-informed tobacco control policies.

KEYWORDS: e-cigarette; GATS 2021; Indonesia; smoking behavior; social cognitive theory; social determinants of health.

1. Introduction

Tobacco use remains a preeminent global public health crisis, acting as a leading preventable cause of morbidity and mortality that claims over eight million lives each year (Nugraheni et al., 2025; Sa & Paek, 2024; Sutrisno et al., 2026; Vallarta-Robledo et al., 2021). The World Health Organization (WHO) reports that these fatalities are primarily driven by chronic conditions, including cardiovascular diseases, respiratory illnesses, and various malignant cancers (Effendi et al., 2024; Prasetya et al., 2025; Reskiaddin et al., 2025; Sa & Paek, 2024; Vallarta-Robledo et al., 2021). While high-income nations have seen gradual

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declines in smoking prevalence, the burden is increasingly concentrated in low-and middle-income countries (LMICs), which are now home to approximately 80% of the world's smokers (Ambarwati et al., 2024; Bigwanto et al., 2023; Kusumawardani et al., 2018; Panduwinata et al., 2018; Prasetya et al., 2025). Indonesia is a critical epicenter of this epidemic, ranking among the top three tobacco consumers globally with an estimated 70.2 million adult users (Bigwanto et al., 2023; Sutrisno et al., 2026; World Health Organization/WHOa, 2021). National data indicate that one in three Indonesian adults currently uses tobacco, with male prevalence alarmingly exceeding 60%, reflecting a stagnant trend that challenges existing public health interventions (Hapsari et al., 2020; Salsabila et al., 2022; Sutrisno et al., 2026; World Health Organization/WHOa, 2021).

Indonesia currently represents a perfect storm for the tobacco industry, created by the convergence of rapid economic expansion and a remarkably permissive regulatory environment (Kramer, 2026). From a socioeconomic perspective, the nation has witnessed a significant rise in its middle class, which comprised 66.35% of the population in 2024 and accounted for over 81% of total household spending (Kramer, 2026). This burgeoning demographic represents a high-consumption environment where annual household spending is projected to exceed \$2.5 trillion by 2030, making it an irresistible growth market for tobacco firms (Jerzyński & Stimson, 2023; Kramer, 2026). Industry actors strategically target this demographic by positioning their products particularly novel items like electronic cigarettes (e-cigarettes), as aspirational lifestyle accessories synonymous with modern, sophisticated living (Hungara & Nobre, 2021; Kramer, 2026).

This economic opportunity is further exploited due to Indonesia's status as a regional outlier in tobacco control; it remains the only country in Southeast Asia that has not ratified the WHO Framework Convention on Tobacco Control (FCTC) (Prasetya et al., 2025; Sutrisno et al., 2026). While regional neighbors such as Singapore and Thailand have implemented stringent bans on novel tobacco products, Indonesia has historically maintained a lenient stance, often regulating vapes as electronic devices rather than tobacco products (Christian et al., 2025; van der Eijk et al., 2022). This lack of comprehensive non-fiscal regulation provided a window for the industry to embed smoking and vaping practices deeply into the social fabric of the urban upper-middle class (Kramer, 2026; Murukutla et al., 2022).

Beyond the clinical health outcomes, tobacco consumption is a major driver of household economic instability in Indonesia (Nugroho & Atmanti, 2020; Nurhasana, 2023). Data from the Central Statistics Agency/*Badan Pusat Statistik* (BPS) reveals that average monthly per capita expenditure on tobacco has reached IDR 76,583, making it the second-highest food-related expenditure after processed foods (Christian et al., 2025). Notably, tobacco spending in Indonesian households now exceeds expenditures on essential staples such as rice, vegetables, and protein sources like fish and eggs (Christian et al., 2025). For low-income families, tobacco costs can consume up to one-third of the total household budget, diverting vital resources from nutrition and education, which subsequently deepens the cycle of poverty and contributes to persistent child malnutrition (Asyary & Veruswati, 2023; Hapsari et al., 2022; Nurhasana, 2023; Prasetya et al., 2025; Rahayu & Rachmah, 2025).

The landscape of tobacco promotion has rapidly evolved from traditional broadcasts to the digital sphere, creating a regulatory vacuum (Kramer, 2026; Wulan et al., 2022). Historically, traditional cigarette advertising was restricted to limited television hours (09:30 pm to 05:00 am), but the borderless nature of the internet has allowed the industry to bypass these constraints (Christian et al., 2025; Wulan et al., 2022). In June 2019, the Minister of Health formally requested the Minister of Communication and Information to block cigarette advertisements on the internet to protect the youth (Wulan et al., 2022). While initial investigations identified 114 channels on major platforms like Facebook, Instagram, and YouTube disseminating tobacco content, subsequent enforcement has remained markedly limited (Wulan et al., 2022). Consequently, social media influencers have emerged as cultural intermediaries, normalizing vaping through strong frames that emphasize aesthetics and peer validation while omitting critical health warnings (Christian et al., 2025; Oo & Tint, 2026).

To address these complex challenges, this study utilizes data from the Global Adult Tobacco Survey (GATS), which serves as the global standard for systematically monitoring adult tobacco use. As a core component of the Global Tobacco Surveillance System (GTSS), GATS utilizes a standard core questionnaire and a rigorous multistage stratified cluster sample design reviewed and approved by international experts. The GATS Indonesia 2021 survey involved over 10,170 selected households, resulting in 9,156 completed individual interviews (World Health Organization/WHOa, 2021). Due to the complexity of the design, specific weighting variables were applied to ensure the findings accurately reflect the national adult population of 205.5 million people. By utilizing this scientifically rigorous dataset, I aim to provide a valid foundation for evidence-based interventions aligned with the Sustainable Development Goals (SDGs) (World Health Organization/WHOa, 2021).

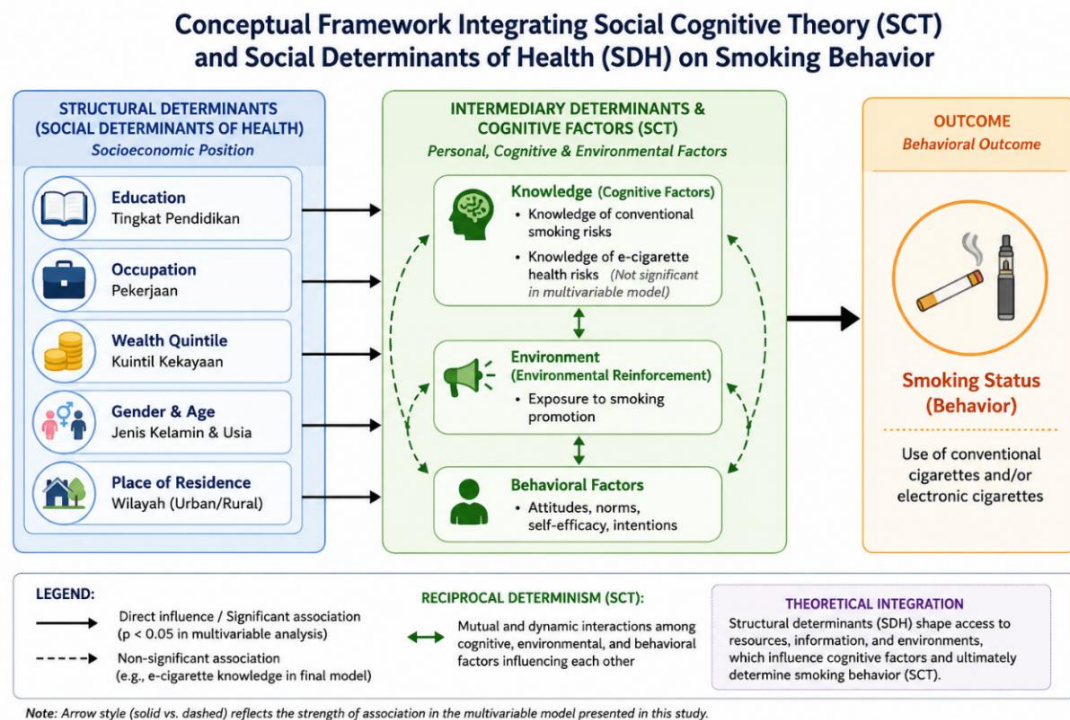


Fig. 1. Integrated conceptual framework of smoking behavior based on SDH and SCT perspectives

Previous analyses of tobacco behavior in Indonesia have frequently examined socioeconomic and behavioral factors in isolation (Edwin & Besral, 2018; Nugraheni et al., 2025). There is a significant research gap in understanding how structural socioeconomic determinants (SDH), such as wealth and education, interact with cognitive environmental reinforcements (SCT), such as risk awareness and promotion exposure, to shape smoking status in the era of e-cigarettes. The primary objective of this study is to examine the integrated influence of structural socioeconomic determinants and cognitive-environmental reinforcements on smoking behavior among Indonesian adults. Specifically, to quantify how factors within the SDH framework and the SCT framework jointly shape smoking status. By utilizing a corrected nationally representative sample from the GATS 2021, to provide empirical evidence to support targeted, platform-sensitive, and equitable tobacco control strategies. To achieve this objective, this study addresses the following research questions: what are the key structural socioeconomic determinants (gender, age, education, occupation, and wealth) that significantly predict smoking status among Indonesian adults? how do cognitive and environmental factors, specifically knowledge of health risks (conventional and e-cigarettes) and exposure to tobacco promotion, influence the likelihood of smoking? how does the integration of SDH and SCT frameworks provide a more comprehensive understanding of the "knowledge-to-behavior gap" in the context of the Indonesian tobacco epidemic?

2. Methods

2.1 Study design and population

This study employed a cross-sectional design using secondary data from the Global Adult Tobacco Survey (GATS) Indonesia 2021. GATS is a nationally representative household survey designed to monitor adult tobacco use and evaluate key tobacco control indicators among individuals aged 15 years and older. The survey was implemented by the Ministry of Health of the Republic of Indonesia in collaboration with the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC). Data collection was conducted through structured, face to face interviews administered by trained enumerators using a standardized questionnaire and sampling protocol.

The 2021 GATS was selected because it represents the most recent and comprehensive dataset available to capture the changing patterns of tobacco and e-cigarette use in Indonesia. The timing of the survey, conducted after a decade since GATS 2011, allows for an updated assessment of socioeconomic inequalities and behavioral determinants in line with evolving tobacco control policies. Indonesia, as one of the countries with the highest smoking prevalence globally, provides a critical context for analyzing these disparities at a national scale.

This study utilized data from GATS 2021, a nationally representative cross-sectional survey conducted using a multistage stratified sampling design. The survey covered all 34 provinces of Indonesia and included 9,156 individuals aged 15 years and older. For the present analysis, we included all adults aged 15 years and older to ensure full alignment with the GATS national sampling frame and to capture smoking behaviors across the entire adult lifespan. After applying inclusion and exclusion criteria for complete information on smoking status and key sociodemographic variables, a total of 9,141 respondents were included in the final analytic sample. This sample represents the national population of approximately 205.5 million Indonesian adults.

2.2 Variables

The dependent variable in this study was current smoking status (smoker binary), which represented respondents' smoking behavior for both conventional and e-cigarettes. The variable was derived from two main questions: "Do you currently use cigarettes on a daily basis, less than daily, or not at all?" and "Do you currently use electronic cigarettes or any other vaping device on a daily basis, less than daily, or not at all?" The responses were combined into a binary outcome: 1 for smokers (daily or less than daily users of either or both products) and 0 for non-smokers. This binary variable was utilized across all weighted bivariate and multivariate analyses.

The independent variables consisted of sociodemographic characteristics. Gender was classified as male or female. Following the standardization of the inclusion criteria to align with the GATS national frame and resolve previous data anomalies, age was grouped into four categories: 15-24 years, 25-44 years, 45-64 years, and ≥ 65 years. Educational attainment was categorized into primary education (up to high school) and higher education (college or postgraduate). Occupational status was divided into eight categories: government employees, private-sector workers, self-employed/farmers, students, homemakers, retirees, and two categories of unemployed (able or unable to work). Place of residence was classified as urban or rural. For socioeconomic status, the wealth quintile (categorized from Lowest to Highest) was used as a proxy, replacing the previous incorrect use of sampling weights as a proxy.

In this study, the wealth quintile was the primary proxy for socioeconomic status, as it provides a more stable and objective measure than self-reported income, which is frequently subject to under-reporting or recall bias in LMIC contexts. The wealth index was constructed using a composite measure of cumulative living standards, derived from a systematic assessment of household asset ownership. Following the standardized GATS

protocol, data on the presence of essential infrastructure and specific amenities within the respondent's home. Key variables included access to electricity, the presence of a flush toilet, and ownership of a television. Furthermore, the ownership of high-value transportation assets, specifically a car and a moped/scooter/motorcycle, was factored into the index calculation. These individual items were aggregated and processed, often through principal component analysis (PCA), to generate a continuous wealth score, which was then divided into five equal categories ranging from the Lowest Quintile (poorest) to the Highest Quintile (wealthiest). This categorization ensures that each quintile represents approximately 20% of the national population, allowing for a precise evaluation of the socioeconomic gradient in smoking behavior.

2.3 Covariate variables

Covariate variables included exposure to tobacco promotion and knowledge of health risks. To address the requirement for clarification, exposure to tobacco promotion was defined based on whether respondents noticed any cigarette marketing or advertisements 30 days prior to the survey across six media sources: newspapers, television, radio, billboards/ advertisements, the internet, and other media. Respondents were coded as 1 (exposed) if they noticed promotion in at least one of these sources and 0 (not exposed) if they had not noticed any advertisements across all six channels.

Knowledge of the health risks of conventional smoking was assessed through the question, "Based on what you know or believe, does smoking tobacco cause serious illness?" (coded as 1 for "Yes" and 0 for "No"). For e-cigarettes, a combined knowledge variable was utilized to ensure the inclusion of the entire synchronized sample (N = 9,141). This variable categorized respondents as "Aware of Risks" (those who believe e-cigarettes cause serious illness) or "Unaware/Uncertain" (which includes those who answered "No," "Don't know," or had never heard of e-cigarettes), thereby resolving the data gaps identified in previous versions of the manuscript.

2.4 Complex sample design and weighting procedures

To produce estimates that accurately reflect Indonesia's adult population of over 205 million people, all statistical analyses accounted for the survey's complex multistage stratified cluster design. The [svy] command suite in Stata version 17.0, which incorporates three critical design variables provided by GATS: [gatsweight], [gatsstrata], and [gatscluster]. The sampling weight [gatsweight] was assigned to each respondent to compensate for the unequal probability of selection at various sampling stages and to adjust for non-response rates within specific geographic and urban-rural strata.

Integrating [gatsstrata] and [gatscluster] into the analytical model was essential to address the clustering effects inherent in the survey design. This technical adjustment is vital for the derivation of accurate point estimates and the calculation of correct variances (standard errors). Without these adjustments, standard statistical procedures would likely underestimate the variance, leading to falsely narrow confidence intervals and inflated significance levels. By employing these rigorous weighting procedures, we ensured that the findings are statistically robust and possess high generalizability to the broader Indonesian adult population.

2.5 Analytical framework and statistical analysis

The analytical framework of this study integrates the Social Determinants of Health (SDH) and Social Cognitive Theory (SCT) perspectives. The SDH framework positions socioeconomic status, education, and occupation as structural factors influencing health behavior, while the SCT highlights the role of individual knowledge and social environment in shaping smoking practices. This combined approach provides a comprehensive

understanding of how both structural and cognitive determinants interact to influence tobacco use among adults in Indonesia.

Descriptive statistics were used to summarize respondents' demographic and socioeconomic characteristics. The distribution of smokers and non-smokers was presented in weighted proportions. Bivariate analysis using the Chi-square test assessed associations between smoking status and independent variables. Variables with p-values < 0.25 in the bivariate analysis were entered into a multivariate logistic regression model to identify independent factors associated with smoking status. Regression results were reported as adjusted odds ratios (AORs) with 95% confidence intervals (CIs). A significance threshold of $p < 0.05$ was applied for all analyses. All statistical analyses were conducted using Stata version 17.0, with the complex sampling design incorporated through survey commands. The analytic strategy was grounded in a positivist epistemological perspective, emphasizing objective quantification and inference from nationally representative data to generalize findings to the broader Indonesian adult population. Furthermore, this study utilized anonymized secondary data from the Global Adult Tobacco Survey (GATS) 2021. Ethical approval for the original data collection was granted by the Health Research Ethics Committee of the National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia (Ref: LB.02.01/2/KE.451/2020, approved on 12th December 2020). As this study involved secondary data analysis without direct contact with participants, no additional ethical clearance was required.

3. Results and Discussion

3.1 Characteristics of respondents

Table 1 presents the characteristics of respondents derived from the Global Adult Tobacco Survey (GATS) Indonesia 2021, comprising 9,141 individuals. Based on weighted estimates, the distribution of respondents was balanced by sex, with males and females each representing 50% of the sample. In terms of age distribution, the largest proportion of respondents was in the 25-44 years age group (41.0%), followed by those aged 45-64 years (29.0%), 15-24 years (21.0%) and ≥ 65 years (9.0%).

Table 1. The characteristics of individual respondents extracted from GATS Indonesia 2021 (n=9,141)

Characteristics	Unweighted		Weighted
	n	%	%
Sex			
Female	4,832	52.86	50.0
Male	4,309	47.14	50.0
Age (years)			
15-24	1,511	16.53	21.0
25-44	3,253	35.59	41.0
45-64	3,301	36.11	29.0
≥ 65	1,076	11.77	9.0
Education			
Primary education	8,307	90.88	90.0
Higher education	834	9.12	10.0
Occupation			
Government Employee	431	4.72	5.0
Non-Government Employee	1,546	16.91	19.0
Self-Employed/Farming	3,371	36.88	34.0
Student	760	8.31	11.0
Homemaker	2,214	24.22	23.0
Retired	161	1.76	2.0
Unemployed, Able to work	402	4.40	5.0
Unemployed, Unable to work	256	2.80	2.0
Region			

Urban	4,081	44.65	57.0
Rural	5,060	55.35	43.0
Smoker Type			
Non-Smoker	6,233	68.16	66.0
Smoker	2,912	31.84	34.0
Exposure to Smoking Promotion			
Not Exposed	2,836	31.03	26.0
Exposed	6,305	68.97	74.0
Knowledge of Conventional Smoking Risks			
Unaware	1,491	16.31	14.0
Aware of Risk	7,650	83.69	86.0
Knowledge of E-cigarette Health Risks			
Unaware	6,230	68.15	62.0
Aware of Risk	2,911	31.85	38.0
Wealth Quintile (5Q)			
Lowest	1,856	20.40	16.0
Lower Middle	2,288	25.03	24.0
Middle	1,579	17.27	18.0
Upper Middle	1,643	17.97	20.0
Highest	1,766	19.32	23.0

This indicates that the sample reflects a broad representation of the adult population rather than being dominated by older adults, as previously misreported. Regarding educational attainment, the majority of respondents had primary education (90%), while only 10.0% had higher education. Occupationally, the largest group consisted of self-employed individuals or farmers (34.0%), followed by homemakers (23.0%) and non-government employees (19.0%). Most respondents resided in urban areas (57.0%). In terms of smoking behavior, 34.0% of respondents were classified as smokers, while 66.0% were non-smokers. A substantial proportion of respondents reported exposure to smoking promotion (74.0%). Additionally, while awareness of conventional smoking risks was relatively high (86.0%), awareness of e-cigarette health risks remained comparatively low (38.0%), indicating a potential gap in public health knowledge.

3.2 Bivariate analysis of smoking-related factors

Table 2 presents the bivariate associations between sociodemographic and contextual factors and smoking status. The analysis showed that sex, age, education, occupation, exposure to smoking risks, knowledge of conventional smoking risks, knowledge of e-cigarette risks, and wealth quintile were significantly associated with smoking status ($p < 0.05$), while region of residence was not statistically significant ($p = 0.053$). Smoking prevalence was markedly higher among males (65.6%) compared to females (2.4%) ($p < 0.001$), confirming that smoking in Indonesia remains strongly gendered. Age was also significantly associated with smoking behavior, with the highest prevalence observed among individuals aged 25-44 years (38.1%) and 45-64 years (34.1%), while older adults (≥ 65 years) showed lower prevalence (26.8%).

Educational level demonstrated a significant relationship, where individuals with primary education had higher smoking prevalence (35.2%) compared to those with higher education (23.5%). Occupational differences were also evident, with higher smoking prevalence observed among non-government employees (49.5%), self-employed/farmers (49.4%), and unemployed individuals able to work (51.2%). Exposure to smoking promotion was significantly associated with smoking behavior ($p < 0.001$), with higher smoking prevalence among those exposed (36.1%) compared to those not exposed (28.1%). Similarly, respondents who were unaware of conventional smoking risks had higher smoking prevalence (49.5%) compared to those who were aware (31.4%).

Table 2. Bivariate analysis of sociodemographic and contextual factors associated with smoking status (n=9,141)

Characteristics	Smoker status		p-value
	Non-smoker (%)	Smoker (%)	
Sex			< 0.001*
Female	97.6	2.4	
Male	34.4	65.6	
Age (years)			< 0.001*
15-24	70.8	29.2	
25-44	61.9	38.1	
45-64	65.9	34.1	
≥ 65	73.2	26.8	
Education			< 0.001*
Primary education	64.8	35.2	
Higher education	76.5	23.5	
Occupation			< 0.001*
Government Employee	68.0	32.0	
Non-Government Employee	50.5	49.5	
Self-Employed/Farming	50.6	49.4	
Student	80.6	19.4	
Homemaker	97.8	2.2	
Retired	70.3	29.7	
Unemployed, Able to work	48.8	51.2	
Unemployed, Unable to work	71.5	28.5	
Region			0.053
Urban	67.2	32.8	
Rural	64.4	35.6	
Exposure to Smoking Promotion			< 0.001*
Not Exposed	71.9	28.1	
Exposed	63.9	36.1	
Knowledge of Conventional Smoking Risks			< 0.001*
Unaware	50.5	49.5	
Aware of Risk	68.6	31.4	
Knowledge of E-cigarette Health Risks			0.001*
Unaware	67.7	32.3	
Aware of Risk	63.2	36.8	
Wealth quintile (5Q)			< 0.001*
Lowest	63.5	36.6	
Lower Middle	59.9	40.1	
Middle	64.5	35.5	
Upper Middle	67.4	32.6	
Highest	73.9	26.1	

Note. p-values were calculated using Chi-Square; *indicated $p < 0.05$.

Wealth quintile s also showed a significant gradient in smoking behavior. Individuals in lower wealth quintile s tended to have higher smoking prevalence compared to those in higher quintiles, indicating that smoking is more concentrated among socioeconomically disadvantaged groups. This pattern suggests that economic vulnerability may increase susceptibility to smoking, potentially due to stress, limited access to health information, or targeted marketing by the tobacco industry. Interestingly, knowledge of e-cigarette health risks showed a significant association ($p = 0.001$), although the direction suggests that individuals aware of e-cigarette risks still exhibited considerable smoking prevalence (36.8%). This may reflect complex behavioral patterns where awareness alone is insufficient to change smoking habits.

3.3 Multivariate analysis of factors associated with smoking

Table 3 presents the results of the multivariate logistic regression analysis, which identifies the independent predictors of smoking status among Indonesian adults by

adjusting for sociodemographic, economic, and cognitive factors. The findings highlight that smoking behavior is influenced by both structural social determinants and individual behavioral mechanisms.

Table 3. Multivariate logistic regression analysis of factors associated with smoking status (n= 9,141)

Variable	Category	AOR	95% CI		p-value
			Lower	Upper	
Sex	Male (Ref)	1.00	-	-	-
	Female	0.013	0.009	0.018	< 0.001*
Age (years)	15-24 (Ref)	1.00	-	-	-
	25-44	1.051	0.752	1.469	0.768
	45-64	0.692	0.474	1.009	0.056**
	≥ 65	0.419	0.265	0.664	< 0.001*
Education	Primary (Ref)	1.00	-	-	-
	Higher education	0.529	0.411	0.682	< 0.001*
Occupation	Government (Ref)	1.00	-	-	-
	Private Sector	1.370	0.980	1.916	0.065**
	Self-Employed/Farming	1.464	1.045	2.052	0.027*
	Student	0.322	0.196	0.529	< 0.001*
	Homemaker	0.799	0.403	1.583	0.517
	Retired	0.884	0.507	1.540	0.659
	Unemployed (Able to work)	1.641	0.999	2.695	0.051**
	Unemployed (Unable to work)	0.774	0.444	1.348	0.362
Wealth quintile (5Q)	Lowest (Ref)	1.00	-	-	-
	Lower Middle	0.804	0.586	1.103	0.174
	Middle	0.686	0.473	0.995	0.047*
	Upper Middle	0.595	0.427	0.829	0.002*
	Highest	0.437	0.310	0.616	< 0.001*
Exposure to Smoking Promotion	Not Exposed (Ref)	1.00	-	-	-
	Exposed	1.249	1.042	1.498	0.017*
Knowledge of Conventional Smoking Risks	Unaware (Ref)	1.00	-	-	-
	Aware Risk	0.367	0.282	0.478	< 0.001*
Knowledge of E-cigarette Health Risks	Unaware (Ref)	1.00	-	-	-
	Aware Risk	0.923	0.770	1.106	0.380

Note. AOR = Adjusted Odds Ratio; CI = Confidence Interval; Significance level: $p < 0.05$ (*); $0 < 0.10$ (**)

Sex is the most dominant predictor of smoking status in the model. Female respondents were less likely to smoke than males (AOR = 0.013; 95% CI = 0.009-0.018; $p < 0.001$). This reflects deep-seated cultural norms in Indonesia where smoking is constructed as a symbol of masculinity and adulthood for men, while remaining socially stigmatized for women. Regarding age, a significant protective trend is observed among the elderly; individuals aged ≥ 65 years have lower odds of smoking compared to the 15-24 age group (AOR = 0.419; 95% CI = 0.265-0.664; $p < 0.001$).

Socioeconomic gradients (SDH) are clearly evident in this updated dataset. Higher educational attainment serves as a significant protective factor, with those completing higher education being less likely to smoke than those with only primary education (AOR = 0.529; 95% CI = 0.411-0.681; $p < 0.001$). Similarly, household wealth is a strong predictor; respondents in the highest wealth quintile have lower odds of smoking compared to those in the lowest quintile (AOR = 0.437; 95% CI = 0.310-0.616; $p < 0.001$). These findings confirm that higher structural status provides better access to health information and stronger health-seeking behaviors.

Work environments and social contexts significantly influence smoking habits. Individuals engaged in self-employment or farming are 1.46 times more likely to be smokers (AOR = 1.464; 95% CI = 1.045-2.052; $p = 0.027$). In contrast, students in this adjusted model exhibit significantly lower odds of smoking (AOR = 0.322; 95% CI = 0.196-0.52; $p < 0.001$).

Furthermore, exposure to smoking promotion acts as an environmental reinforcement that increases the likelihood of smoking by 1.25 times (AOR = 1.249; 95% CI = 1.042-1.498; $p = 0.017$). From a behavioral standpoint, health literacy plays a critical role. Knowledge of conventional smoking risks is highly protective, reducing the odds of smoking (AOR = 0.367; 95% CI = 0.282-0.478; $p < 0.001$). However, awareness of e-cigarette health risks does not show a statistically significant association with smoking status in this model (AOR = 0.923; 95% CI = 0.770-1.106; $p = 0.380$). This indicates a knowledge gap where awareness of novel tobacco products has not yet reached a threshold sufficient to deter behavior, especially when compared to the well-established risks of conventional smoking. The findings of this study confirm that smoking behavior among Indonesian adults is shaped by a complex and dynamic interaction between structural socioeconomic determinants, cultural identities, and cognitive-environmental reinforcements. By integrating SDH and SCT perspectives, a comprehensive understanding emerges of why tobacco use remains stagnant in Indonesia despite various control efforts.

3.4 *The age gradient and lifespan implications*

An age distribution where the 25-44 years group represents the largest proportion of adults (41.0%). Multivariate results reveal a significant protective trend associated with aging; individuals aged ≥ 65 years have lower odds of smoking compared to those aged 15-24 (AOR = 0.419; $p < 0.001$). This declining prevalence among the elderly is often attributed to the onset of chronic illnesses and physiological decline, which heightens health concerns and motivates cessation (Effendi et al., 2024; Hapsari et al., 2022; Kusumawardani et al., 2018; Prasetya et al., 2025; Widyaningsih et al., 2022). Conversely, the higher risk observed in younger cohorts (15-24 and 25-44 years) underscores that smoking initiation and addiction predominantly occur in early life, with 83% of smokers in Indonesia starting between the ages of 14 and 25 (Kusumawardani et al., 2018; Prasetya et al., 2025; Sadarang, 2021; Widyaningsih et al., 2022). This suggests that while older adults may quit due to deteriorating health, younger populations remain highly vulnerable to initiation (Nargis et al., 2019; Sa & Paek, 2024).

3.5 *Gender as a dominant cultural determinant*

Sex remains the strongest predictor of smoking status in the Indonesian context. Multivariate analysis results indicate that female respondents have substantially lower odds of smoking compared to males (AOR = 0.013; 95% CI = 0.009-0.018; $p < 0.001$). This extreme disparity is not merely demographic but is deeply rooted in gendered social identities. In Indonesia, smoking is culturally constructed as a symbol of masculinity, strength, and social identity for men (Djutaharta et al., 2021; Effendi et al., 2024; Kusumawardani et al., 2018; Prasetya et al., 2025). This is frequently encapsulated by the sentiment that smoking is a prerequisite for real manhood, a perspective explored in depth through the iconic quote, "If I don't smoke, I'm not a real man," found to be common among Indonesian male adolescents and adults (Djutaharta et al., 2021; Effendi et al., 2024; Kusumawardani et al., 2018; Prasetya et al., 2025; Salsabila et al., 2022).

Conversely, smoking behavior among women faces significant social stigma, particularly in rural areas, which serves as a powerful traditional deterrent (Effendi et al., 2024). Sadarang (2021) further elucidates that female smokers in Indonesia are often stigmatized as "morally flawed" individuals because their traditional social roles are constructed as the primary guardians of family health and morality. Although perceptions of modernity have begun to shift the image of smoking toward a "glamorous" urban lifestyle in certain demographic circles, the prevailing cultural norms against female tobacco use remain a dominant protective factor in Indonesia's tobacco epidemic (Sadarang, 2021).

3.6 Education, wealth, and economic dynamics

The analysis demonstrates a clear socioeconomic gradient where higher structural status acts as a protective shield. Individuals with higher education are significantly less likely to smoke than those with primary education (AOR = 0.529; $p < 0.001$). This relationship is further elucidated by the Wealth quintile analysis, where respondents in the highest wealth quintile exhibit 56.3% lower odds of smoking compared to the lowest quintile (AOR = 0.437; $p < 0.001$).

The “pro-poor” pattern of the epidemic in Indonesia is particularly alarming when examining household expenditure. Data indicate that the average monthly per capita expenditure on tobacco and betel products has reached IDR 76,583, making it the second-highest food-related expenditure after processed foods (Christian et al., 2025). Crucially, this figure even exceeds expenditures on primary staples such as rice (IDR 69,786), vegetables (IDR 53,864), and protein sources like fish (IDR 53,534) or eggs and milk (IDR 35,241) (Christian et al., 2025; Donaldson et al., 2022). This represents a significant diversion of resources; in impoverished households, paternal smoking often leads to the reallocation of limited funds from nutritious food to tobacco, which directly worsens child malnutrition and deepens the intergenerational cycle of poverty (Asyary & Veruswati, 2023; Bella et al., 2023; Christian et al., 2025; Danal et al., 2021; Djutaharta et al., 2022; Prasetya et al., 2025). This economic dynamic illustrates how SDH factors, such as low wealth, are reinforced by the addictive nature of nicotine, trapping vulnerable families in a cycle where tobacco expenditure competes with essential human development needs (Nurhasana, 2023).

3.7 Excise dynamics and the trading down phenomenon

The protective effect of wealth is also mediated by national fiscal measures. Although the Indonesian government has consistently implemented tobacco excise tax increases/*cukai hasil tembakau*), its effectiveness is frequently undermined (Bigwanto et al., 2023; Djutaharta et al., 2021). During the COVID-19 pandemic, the tobacco industry successfully utilized news media to pressure the government for tax incentives and payment extensions, arguing for economic survival (Bigwanto et al., 2023).

Furthermore, price-related policies alone are insufficient because low-income smokers often engage in trading down (Bella et al., 2023; Bigwanto et al., 2023; Nurhasana, 2023). Instead of quitting, addicts often switch to cheaper, lower-tiered cigarette brands, which are widely available for as low as USD 0.45 per pack, or transition to novel tobacco products like e-cigarettes to maintain their nicotine dependence (Bella et al., 2023; Bigwanto et al., 2023). This behavior highlights a critical policy gap where the multitiered tax system allows the pro-poor pattern to persist despite excise increases (Bella et al., 2023; Prasetya et al., 2025).

3.8 Reciprocal determinism and the knowledge-behavior gap (SCT)

From an SCT perspective, the environment plays a critical role through reciprocal determinism, where behavior is shaped by the continuous interaction between personal cognition and environmental reinforcements (de la Fuente et al., 2023; Panduwinata et al., 2018; Sulistyani et al., 2021). While knowledge of conventional smoking risks is highly protective (AOR = 0.367; $p < 0.001$), awareness regarding e-cigarette risks was not

This non-significance indicates a critical knowledge-to-behavior gap driven by the digital landscape. E-cigarettes are systematically framed as modern lifestyle accessories through pervasive social media marketing (Christian et al., 2025; Kramer, 2026). Digital surveillance indicates that tobacco-related content on platforms like TikTok has an engagement rate 35.8 times higher than on YouTube, creating a massive reach among younger demographics (Bigwanto et al., 2023; Sutrisno et al., 2026). Social media influencers utilize strong frames that focus on emotional resonance, aesthetics, and peer validation rather than health facts (Christian et al., 2025; Kusumawardani et al., 2018;

Susanto et al., 2025; Sutrisno et al., 2026; Vallarta-Robledo et al., 2021). These frames operate as heuristics, allowing audiences to form positive opinions about vaping without critically evaluating health risks, thereby effectively neutralizing the protective impact of individual knowledge (Christian et al., 2025; Susanto et al., 2025).

3.9 Cultural normalization and the educational environment

The protective effect of being a student (AOR = 0.322; $p < 0.001$) suggests that academic environments can foster anti-smoking norms. However, this protection is constantly challenged by deep-rooted cultural practices (Djutaharta et al., 2021; Effendi et al., 2024; Kusumawardani et al., 2018; Prasetya et al., 2025). In Indonesian social settings, offering a cigarette is often viewed as a symbol of friendship and social inclusion (Swatan et al., 2020). The cultural norm of politely rejecting a host's offer is often considered impolite, creating an environment where smoking is socially reinforced as a prerequisite for masculinity and networking (Djutaharta et al., 2021; Prasetya et al., 2025; Swatan et al., 2020).

Peer groups act as primary drivers of reciprocal determinism, where the desire for social acceptance often overrides health literacy (Panduwinata et al., 2018; Prasetya et al., 2025; Wibowo et al., 2019). Furthermore, the lack of a unified stance from religious organizations regarding the haram (forbidden) status of e-cigarettes contributes to public confusion (Djutaharta et al., 2021; Prasetya et al., 2025). In a society where religious guidance strongly influences perception, the ongoing polemic among faith-based groups allows novel products to be perceived as more acceptable than conventional tobacco, further widening the gap between scientific health risks and actual behavior (Djutaharta et al., 2021; Prasetya et al., 2025).

3.10 Study limitations

This study has several limitations. First, the cross-sectional design of the GATS 2021 survey allows for the identification of associations but precludes the establishment of temporal or causal relationships between socioeconomic determinants and smoking status. While we have identified significant predictors, longitudinal data would be required to confirm the direction of these effects, particularly regarding how changes in wealth or education over time influence cessation or initiation.

Second, the study relies entirely on self-reported responses, which are susceptible to recall bias and social desirability bias. In the context of tobacco research, participants, especially women and youth, may under-report their smoking habits due to the prevailing social stigma or the general awareness that smoking is an unhealthy behavior. Although GATS utilizes standardized global protocols and trained enumerators to minimize these errors, the lack of biochemical validation (such as cotinine testing) remains a constraint.

Third, while the wealth quintile serves as a robust and objective proxy for long-term socioeconomic status based on asset ownership, it does not directly capture immediate household liquid income or specific expenditure patterns. This limitation means that the findings reflect the impact of overall living standards rather than the direct effect of short-term fluctuations in purchasing power. Furthermore, this study is limited to the variables provided in the GATS dataset; therefore, certain unmeasured confounders, such as parental smoking history, genetic predispositions, and the specific density of tobacco retailers in a respondent's neighborhood, could not be incorporated into the multivariate model.

Despite these limitations, the strengths of this study are significant. The use of a large, nationally representative sample and a scientifically rigorous, standardized global protocol ensures that the findings possess high statistical power and are highly generalizable to the broader Indonesian adult population. By integrating structural (SDH) and cognitive (SCT) frameworks, provided a more holistic evidence base than previous studies that examined these factors in isolation.

3.11 Recommendations for digital regulatory strengthening

Based on these findings, recommend a significant recalibration of Indonesia's tobacco control strategies to address the evolving digital landscape. The government must expand the legal definition of Tobacco Advertising, Promotion, and Sponsorship (TAPS) to explicitly encompass influencer marketing and user-generated content (UGC). Current regulations, such as Government Regulation No. 109 of 2012, face severe enforcement challenges because they primarily target traditional media, leaving a "regulatory vacuum" in the digital sphere. Influencers often act as cultural intermediaries who blur the boundary between commercial messaging and personal communication, making vaping appear socially acceptable and desirable without the obligation to include health warnings. Therefore, relevant ministries should implement algorithmic monitoring and stricter enforcement protocols for platforms like TikTok and Instagram, where engagement for tobacco content is disproportionately high. Mandatory health warnings and age-restriction labels must be strictly applied to all organic promotional content to protect vulnerable youth demographics.

Furthermore, tobacco control in Indonesia must prioritize gender-sensitive interventions that specifically target the cultural construction of masculinity. Since smoking is deeply embedded in the social identity of Indonesian men, often framed as a prerequisite for "real manhood," public health campaigns should focus on reframing masculinity norms. Public health messaging should move beyond clinical risks and instead emphasize the role of men as protectors of family health and financial stability. Framing the decision to quit as an act of male responsibility to care for women and children can help dismantle the cultural normalization of tobacco use in patriarchal households.

Finally, equity-focused strategies must be implemented to reach low-income and less-educated populations who currently bear the highest burden of the epidemic. Recommend simplifying the multitiered excise system to prevent "trading down" to cheaper brands and integrating smoking cessation services into the national health insurance system (BPJS). Only by addressing both the structural socioeconomic disparities and the cognitive heuristics created by digital marketing can Indonesia effectively mitigate the future dual burden of conventional and electronic cigarette use.

4. Conclusions

This study concludes that smoking behavior among Indonesian adults is shaped by a complex interaction between structural socioeconomic determinants and cognitive-environmental factors. Addressing the first research question, the analysis confirms that male sex remains the most powerful predictor of smoking status, a finding deeply rooted in the cultural construction of masculinity and the traditional role of men as heads of households with primary financial responsibilities. Meanwhile, higher education and the highest wealth quintile serve as the principal structural protective factors that lower the probability of smoking, whereas individuals working in the agricultural sector or those who are self-employed exhibit significantly higher vulnerability to tobacco use. In response to the second research question, findings indicate that exposure to tobacco promotion across various media significantly reinforces smoking behavior as a potent form of environmental reinforcement. From a cognitive standpoint, although knowledge of the health risks associated with conventional smoking is highly effective in reducing smoking odds, awareness of e-cigarette health risks was not statistically significant in the adjusted model, indicating a critical health literacy gap regarding novel tobacco products. The integration of the Social Determinants of Health (SDH) and Social Cognitive Theory (SCT) frameworks provides an in-depth understanding of the knowledge-to-behavior gap, addressing the third research question. This gap is largely fueled by an aggressive digital marketing landscape where content on social media platforms like TikTok and Instagram normalizes vaping as a symbol of modern lifestyle, effectively overriding individual risk awareness through the influence of peer groups and cognitive heuristics.

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Author Contribution

Conceptualization, Methodology, Formal Analysis, Data Curation, Writing–Original Draft Preparation, Writing – Review & Editing, Visualization, and Project Administration: R.I.N. All authors have read and agreed to the published version of the manuscript.

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Ethical Review Board Statement

This study utilized anonymized secondary data from the Global Adult Tobacco Survey (GATS) 2021. Ethical approval for the original data collection was granted by the Health Research Ethics Committee of the National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia (Ref: LB.02.01/2/KE.451/2020, approved on 12th December 2020). As this study conducted secondary data analysis without direct interaction with human participants, no additional ethical approval was required.

Informed Consent Statement

Not available. This study used secondary data from the Global Adult Tobacco Survey (GATS) 2021, which did not involve the collection of identifiable personal data from individual participants.

Data Availability Statement

The dataset used in this study is publicly available. The data analyzed in this study were obtained from the Global Tobacco Surveillance System (GTSS) Data Repository and can be accessed at: <https://extranet.who.int/ncdsmicrodata/index.php/catalog/955>.

Conflicts of Interest

The author declares no conflict of interest.

Declaration of Generative AI Use

During the preparation of this work, the author used several generative and assistive artificial intelligence tools, including ChatGPT (OpenAI, San Francisco, CA, USA), NotebookLM (Google, Mountain View, CA, USA), Elicit (Ought, San Francisco, CA, USA), Grammarly (Grammarly Inc., San Francisco, CA, USA), and DeepL Translator (DeepL SE, Cologne, Germany). These tools were used to assist in literature exploration, idea organization, improving clarity, refining grammar and academic tone, and translating or paraphrasing portions of the text. After using these tools, the author reviewed and edited the content as needed and takes full responsibility for the accuracy and integrity of the final manuscript.

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