



## Research

# Who Successfully Quits Smoking in Indonesia? A Survival Analysis of GATS 2021

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### ABSTRACT

Tobacco use is a major health burden in Indonesia, especially among men, while the use of cessation aids remains low. Although more individuals are attempting to quit, factors influencing successful cessation are not fully understood. This cross-sectional study analyzed data from the 2021 Global Adult Tobacco Survey (GATS) Indonesia. A total of 1,111 respondents aged  $\geq 15$  years who had ever smoked were included. Kaplan-Meier survival curves and Cox proportional hazard models assessed demographic and behavioral predictors of smoking cessation. Among respondents, 68.9% had quit smoking for at least 12 months. Women were more likely to quit than men (aHR = 4.23; 95% CI: 2.64–6.75). Education level was positively associated with cessation: medium (aHR = 1.79) and high (aHR = 2.17) education levels had higher quit rates than low education. Only students showed significantly higher cessation rates among employment groups (aHR = 6.19). Exposure to e-cigarettes was linked to lower cessation likelihood, although frequency of use was not significant. Female gender and higher education are key factors in successful smoking cessation. Programs should address social disparities and offer targeted support for less-educated and socially disadvantaged populations.

## 1. Introduction

Tobacco use remains a leading cause of preventable illness and death globally, contributing to more than 8 million deaths annually, including 1.3 million from secondhand smoke exposure. While smoking prevalence has declined in many parts of the world, Southeast Asia, particularly Indonesia, continues to bear a significant burden, with nearly 80% of the world's 1.3 billion smokers residing in low- and middle-income countries (1).

Indonesia ranks among the countries with the highest prevalence of tobacco use, especially among men. According to the Global Adult Tobacco Survey (GATS) 2021, overall tobacco use prevalence remained relatively unchanged from 2011 to 2021. However, the use of electronic cigarettes increased tenfold, from 0.3% to 3.0% over the same period (2).

Encouragingly, quit attempts among Indonesian smokers rose from 30.4% in 2011 to 43.8% in 2021. Yet, the utilization of evidence-based cessation support, such as quitlines and nicotine replacement therapy, remains limited. Studies suggest that smoking cessation success is influenced by sociodemographic factors such as gender, education, and occupation (3–6).

Despite national-level data from surveys like GATS, limited research has examined the demographic and behavioural determinants of smoking cessation in Indonesia. This study addresses that gap by analysing individual-level data from GATS 2021 using survival analysis and Cox regression to identify key factors associated with cessation. The findings aim to inform more targeted and equitable tobacco control interventions

## 2. Method

This study employed a cross-sectional design using secondary data from the 2021 Global Adult Tobacco Survey (GATS) Indonesia. GATS is a nationally representative household survey design to monitor tobacco use among adults and evaluate key tobacco control indicators. The dataset includes individuals aged 15 years and older from all provinces in Indonesia (Centers for Disease Control and Prevention (CDC); & World Health Organization (WHO), 2023).

The 2021 GATS Indonesia used a stratified multistage cluster sampling design to ensure national representativeness. A total of 9,156 individuals were interviewed. For the analysis, only respondents who reported ever smoking were included. Those with incomplete data on key variables were excluded, resulting in a final sample of 1,111.

The study population comprised individuals aged 15 years and older with a history of smoking. Key variables analyzed included gender (male/female), age at smoking initiation (in years), highest education level completed, employment type, exposure of electronic cigarette information, and use of electronic cigarettes.

The primary outcome variable was smoking cessation, defined as individuals who previously smoked but had quit at least 12 months at the time of the survey. Independent variables included sociodemographic factors (gender, education, employment), age at first smoking, and electronic cigarette-related factors (exposure to information and usage status). Comparisons were made across these categories to examine their association with smoking cessation.

Descriptive analyses were conducted to summarize participants' characteristics. Kaplan-Meier survival curves were generated to illustrate the probability of smoking cessation over time across different group. The log-rank test was used to compare survival distributions between categories of independents variable in univariate analysis.

To identify factors associated with smoking cessation while controlling for potential confounders, Cox proportional hazard regression was applied. Hazard ratios (HRs) and 95% confidence interval (CIs) were calculated to quantify the association between independent variables and the likelihood of quitting smoking.

To ensure nationally representative estimates and correct standard error calculations, all analyses incorporated the sampling weights provided in GATS dataset. The complex survey design was accounted for by specifying the primary sampling unit (PSUs). The proportional hazard assumption was evaluated using Schoenfeld residuals. All statistical significances were set at  $p < 0.05$ .

### 3. Results & Discussion

A total of 1,111 individuals who reported ever smoking were included in the study. Among them, 766 participants (68.9%) had abstained from smoking for at least 12 months at the time of the survey and were considered successful quitters. Table 1 presents baseline characteristics stratified by smoking cessation status. The median age of participants was 48 years (range: 15-93), and the median age of smoking initiation was 17 years (range: 5-70). Most respondents were male (85.8%), had a medium level of education (46.4%), were employed (72.6%), and had been exposed to e-cigarette information (54.4%). Among those exposed, only 0.5% reported daily use of e-cigarettes (Table 1).

**Table 1.** Baseline Characteristics of Respondent by Smoking Cessation Status

No	Variables	Smoking Cessation			
		Yes (n = 766)		No (n = 345)	
		n	%	n	%
1	Age (median, range)	50 (15 - 93)		42 (15 - 86)	
2	Age of initiation				
	< 20 years	528	68.9	267	77.4
	≥ 20 years	238	31.1	78	22.6
3	Gender				
	Male	639	83.4	315	91.3
	Female	127	16.6	30	8.7
4	Level of education				
	Low	332	43.3	149	43.2
	Medium	344	44.9	172	49.8
	High	90	11.8	24	7.0
5	Employment status				
	Working	540	70.5	267	77.4
	Student	44	5.7	29	8.4
	Not working	107	14.0	21	6.1
	Unemployment	30	4.0	16	4.6
	Unable to work (health)	45	5.8	12	3.5
6	E-cigarette exposure				
	Yes	418	54.6	188	54.5
	No	348	45.4	157	45.5
7	E-cigarette use				
	Daily use	2	0.5	1	0.5

No	Variables	Smoking Cessation			
		Yes (n = 766)		No (n = 345)	
		n	%	n	%
	Occasional use	17	4.1	15	8.0
	Not using at all	399	95.5	172	91.5

Figure 1 presents the Kaplan-Meier survival curves illustrating differences in smoking cessation patterns by age at smoking initiation (left) and by gender (right). Individuals who initiated smoking at an older age exhibited a significantly higher likelihood of quitting over time compared to those who began smoking before the age of 20 (log-rank test:  $\chi^2 = 9.14$ ,  $p=0.0025$ ). When stratified by gender, female respondents demonstrated a substantially greater probability of smoking cessation compared to male respondents (log-rank test:  $\chi^2 = 45.6$ ,  $p<0.001$ ).

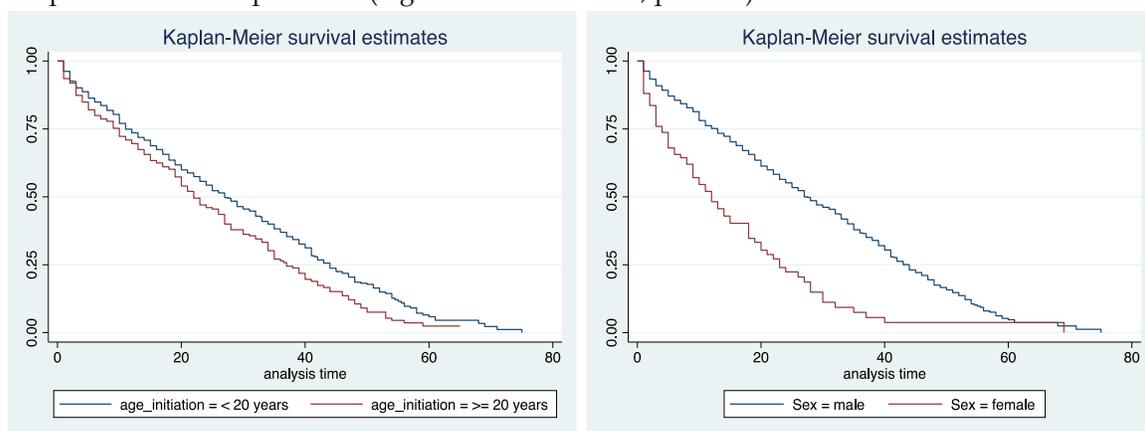


Figure 1. Kaplan-Meier Curve of Smoking Cessation by Age of Smoking Initiation and Gender

The Kaplan-Meier survival analysis revealed that both education attainment and employment status were significantly associated with smoking cessation. Individuals with higher levels of education showed a faster and greater likelihood of quitting smoking over time compared to those with lower educational backgrounds. This difference was statistically significant (log-rank test:  $\chi^2 = 44.3$ ,  $p<0.001$ ). Similarly, smoking cessation patterns varied across employment groups. Student exhibited the highest probability of quitting, while individuals unable to work due to health reasons had the lowest cessation rates. The overall difference in survival functions across employment categories was also statistically significant (log-rank test:  $\chi^2 = 77.6$ ,  $p<0.001$ ) (Figure 2).

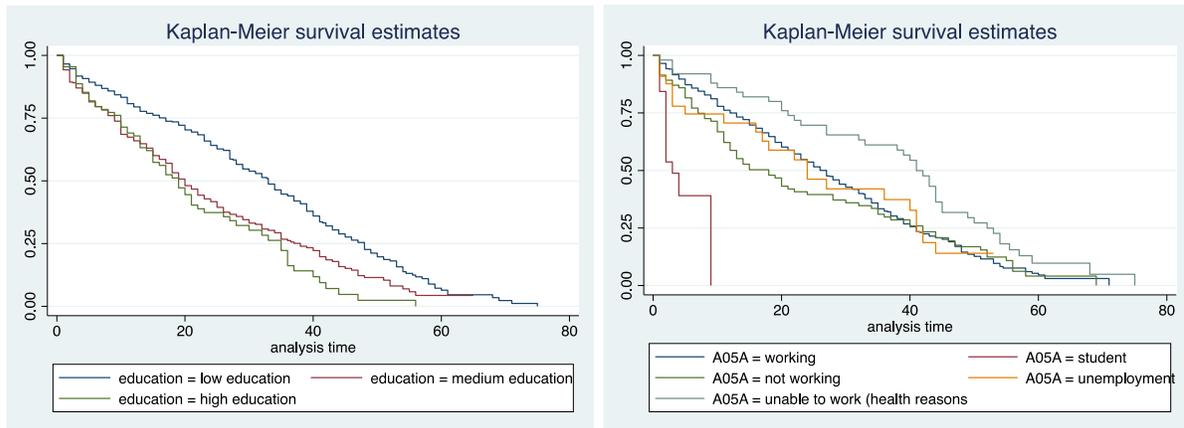


Figure 2. Kaplan-Meier Curve of Smoking Cessation by Education and Employment Status

The smoking cessation patterns based on e-cigarette exposure (left) shown that individuals not exposed to e-cigarettes had a significantly higher likelihood of quitting over time compared to those who were exposed (log-rank test:  $X^2 = 43.89$ ,  $p < 0.001$ ). However, when stratified by frequency of e-cigarettes use, there is no significant difference in cessation was observed among the category (log-rank test:  $X^2 = 1.98$ ,  $p = 0.3709$ ).

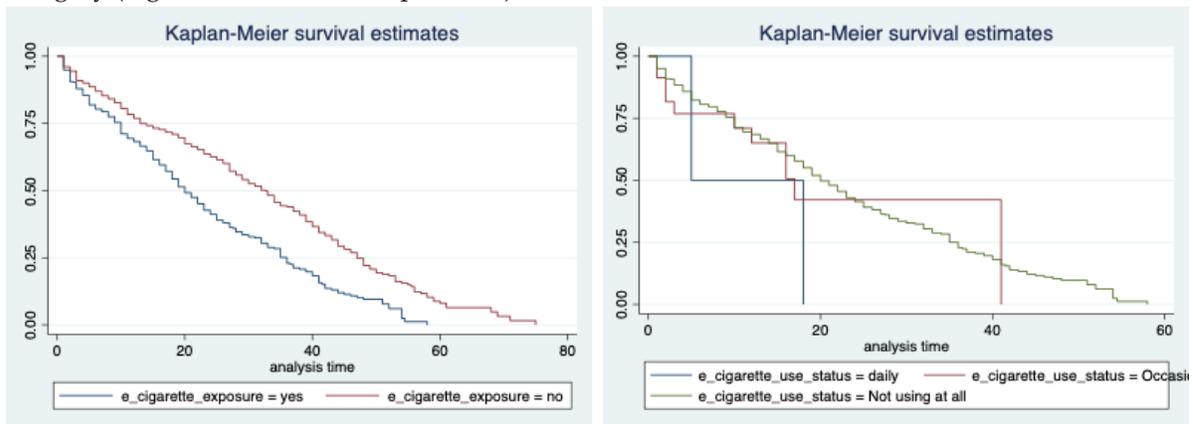


Figure 3. Kaplan-Meier Curve of Smoking Cessation by E-Cigarette Exposure and Use Status

Gender and level of education were the significant variables associated with smoking cessation among respondents. Compared to male, female was significantly more likely to quit smoking (aHR=4.23; 95% CI: 2.64-6.75). Individuals with medium (aHR=1.79; 95% CI: 1.36-2.37) and high levels of education (aHR=2.17; 95% CI: 1.49-3.14) were also more likely to quit than those with low education.

Students had the highest likelihood of quitting (aHR=6.19; 95% CI: 3.47-11.05), while those who were not working (aHR=0.54; 95% CI: 0.35-0.84) or unable to work due to health reasons (aHR=0.37; 95% CI: 0.15-0.93) had significantly lower likelihoods. Based on employment status, unemployment was not significantly associated ( $p = 0.604$ ).

Initiating smoking at age 20 or older was not significantly related to quitting (aHR=1.23; p=0.179). likewise, occasional (aHR=0.40; p=0.234) or non-use of e-cigarettes (aHR=0.45; p=0.276) was not significantly different from daily use in predicting smoking cessation.

**Table 2.** *Determinant of Smoking Cessation*

Variable	HR	p-value	95%CI	aHR	p-value	95%CI
Age of initiation						
<20 years	1			1		
≥20 years	1.29	0.003	1.09 – 1.53	1.23	0.179	0.91 – 1.65
Gender						
Male	1			1		
Female	2.25	<0.001	1.76 – 2.88	4.22	<0.001	2.64 – 6.75
Level of education						
Low	1			1		
Medium	1.62	<0.001	1.36 – 1.92	1.79	<0.001	1.36 – 2.37
High	1.95	<0.001	1.49 – 2.54	2.17	<0.001	1.49 – 3.14
Employment status						
Working	1			1		
Student	6.5	<0.001	3.87– 11.23	6.19	<0.001	3.47 – 11.05
Not working	1.22	0.346	0.88 – 1.43	0.54	0.006	0.35 – 0.84
Unemployment	1.04	0.867	0.68 – 1.59	0.84	0.604	0.44 – 1.61
Unable to work (health)	0.63	0.005	0.46 – 0.87	0.37	0.035	0.15 – 0.93
E-cigarette exposure						
Yes	1			1		
No	0.59	<0.001	0.49 – 0.69			
E-cigarette use						
Daily use	1			1		
Occasional use	0.43	0.270	0.95 – 1.93	0.40	0.243	0.87 – 1.85
Not using at all	0.39	0.189	0.09 – 1.58	0.45	0.276	0.11 – 1.87

Females are more likely to successfully quit smoking than males. This difference can be better understood by examining the social and cultural contexts that influence smoking behavior in Indonesia. In patriarchal societies that uphold traditional values, such as Indonesia, smoking is often strongly associated with masculinity. It is commonly perceived as a symbol of male maturity or authority and remains socially acceptable, despite widespread awareness of its adverse health effects.

In contrast, females who smoke are often subjected to greater social pressure and stigma (Nabil et al., 2024; Sadarang, 2021). They are morally judged for violating cultural norms and their expected social role as caregivers and protectors of family health. In certain traditional communities, such as the matrilineal Minangkabau society, women hold essential roles not only in caregiving but also in preserving and transmitting cultural values. Within this context, smoking among women is seen as

deviant behavior that contradicts traditional norms and can provoke both internal conflict and external disapproval from family members and the broader community.

The patterns and motivations for smoking differ significantly between males and females, and these differences greatly influence cessation outcomes. Males tend to smoke for the stimulant effect of nicotine and as a part of social interaction, while females are more likely to smoke due to non-pharmacological reasons such as stress, routine, and social pressure. Consequently, women's success in quitting smoking often depends more heavily on emotional support, family involvement, and strong social norms that discourage smoking (Dieleman et al., 2021).

This aligns well with the smoking cessation services available in Indonesia, which are predominantly support-based. These include counseling, community-based programs, and household-level smoke-free initiatives that emphasize behavioral change through social reinforcement. A study conducted in the Ontario population supports this perspective, showing that females are more likely than males to utilize a variety of cessation strategies, including nicotine patches, varenicline, quitlines, and self-help materials (Jayakumar et al., 2020). These findings suggest that women are more inclined to adopt multi-strategy approaches and actively engage with available support systems in their efforts to quit smoking.

The findings of this study, which demonstrate a linear association between educational attainment and the likelihood of successful smoking cessation, align with prior research (Andersen et al., 2023; Cao et al., 2023; Ruokolainen et al., 2021; Zhuang et al., 2015). Individuals with higher levels of education tend to have a greater capacity to comprehend health-related information and risks, improved access to healthcare services—including cessation programs—and stronger self-regulation and stress management skills, all of which support cessation efforts.

Educational level also correlates with environmental and social factors that influence cessation outcomes. Smokers with lower education are often embedded in social settings that are more accepting of tobacco use, where smoking is normalized and reinforced by peers or family members. Such environments may diminish motivation to quit and increase relapse risk due to frequent exposure to smoking cues (8).

Moreover, individuals with lower education levels often experience financial and psychological constraints that limit their ability to quit smoking successfully (6,9). Tobacco companies frequently target these populations with price reductions and marketing strategies, making cessation more difficult. Even when cessation support services such as quitlines are freely available, cost-related concerns and lower perceived benefit may discourage their use. Additionally, lower self-efficacy and limited coping resources to manage stress or withdrawal symptoms represent further psychological barriers to cessation success.

Nonetheless, this study is not without limitations. First, the use of secondary data from a cross-sectional survey restricts the ability to draw causal conclusions. In addition, the dataset lacked several potentially influential variables, such as levels of nicotine dependence, intention or motivation to quit, and exposure to anti-smoking campaigns or cessation interventions. Moreover, since smoking status and cessation outcomes were based on self-reports, the data may be influenced by recall bias or social desirability. Despite these limitations, the study contributes meaningful

insights into smoking cessation patterns among different demographic groups in Indonesia and highlights the importance of tailored, support-oriented cessation strategies.

#### 4. Conclusion

This study revealed that gender and educational attainment play a significant role in smoking cessation among Indonesian adults. Women were more likely to quit smoking compared to men, which may be influenced by cultural norms and social expectations that discourage smoking among females. Additionally, participants with moderate to high education levels had greater chances of quitting than those with lower educational backgrounds. In terms of employment, students showed higher cessation success, whereas individuals who were not employed or unable to work due to health limitations had lower likelihoods of quitting. These results emphasize the importance of designing cessation programs that are sensitive to social and demographic differences. Tailored interventions that offer supportive approaches for disadvantaged groups – particularly those with less education or limited work capacity – may improve cessation outcomes. Further investigation is needed to examine other potential determinants such as psychological conditions, environmental triggers, and motivational factors.

#### 5. References

- Andersen, A. J., Hecker, I., Wallez, S., Witteveen, A., Lora, A., Mittendorfer-Rutz, E., Corrao, G., Walter, H., Haro, M., & Sijbrandij, M. (2023). Are we equally at risk of changing smoking behavior during a public health crisis? Impact of educational level on smoking from the TEMPO cohort. *BMC Public Health*. <https://hal.science/hal-04168195v1>
- Cao, P., Jeon, J., Tam, J., Fleischer, N. L., Levy, D. T., Holford, T. R., & Meza, R. (2023). Smoking Disparities by Level of Educational Attainment and Birth Cohort in the U.S. *American Journal of Preventive Medicine*, 64(4), S22–S31. <https://doi.org/10.1016/j.amepre.2022.06.021>
- Centers for Disease Control and Prevention (CDC), & World Health Organization (WHO). (2023). *Global Adult Tobacco Survey (GATS): Survey Tools*. GTSS Academy. <https://www.gtssacademy.org/survey-tools/gats/>
- Dieleman, L. A., van Peet, P. G., & M Vos, H. M. (2021). Gender differences within the barriers to smoking cessation and the preferences for interventions in primary care a qualitative study using focus groups in The Hague, The Netherlands. *BMJ Open*, 11(042623), 1–9. <https://doi.org/10.1136/bmjopen-2020-042623>
- Jayakumar, N., Chaiton, M., Zhang, B., Selby, P., & Schwartz, R. (2020). Sex Differences in Use of Smoking Cessation Services and Resources: A Real-World Study. *Tobacco Use Insights*, 13, 1–8. <https://doi.org/10.1177/1179173X20901500>
- Nabil, A. S., Pramiyanti, A., & Wulandari, A. (2024, novembro 30). *Stigma Sosial pada Perempuan Perokok di Solok Sumatera Barat*. Sang Pencerah: Jurnal Ilmiah Universitas Muhammadiyah Buton. <https://www.jurnal-umbuton.ac.id/index.php/Pencerah/article/view/6157/3013>

- Ruokolainen, O., Härkänen, T., Lahti, J., Haukkala, A., Heliövaara, M., & Rahkonen, O. (2021). Association between educational level and smoking cessation in an 11-year follow-up study of a national health survey. *Scandinavian Journal of Public Health*, 49(8), 960. <https://doi.org/10.1177/1403494821993721>
- Sadarang, R. A. I. (2021). Factors Associated With Quitting Smoking in Indonesia. *Journal of Preventive Medicine and Public Health*, 54(2), 137-144. <https://doi.org/10.3961/JPMPH.20.293>
- Zhuang, Y. L., Gamst, A. C., Cummins, S. E., Wolfson, T., & Zhu, S. H. (2015). Comparison of Smoking Cessation Between Education Groups: Findings From 2 US National Surveys Over 2 Decades. *American Journal of Public Health*, 105(2), 379. <https://doi.org/10.2105/AJPH.2014.302222>