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Behavioral Responses of Nonsmokers to Environmental Tobacco Smoke Exposure

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ABSTRACT

Second-hand smoke (SHS) exposure remains a significant public health issue among Indonesian adolescents, particularly in areas where smoking is socially accepted and smoke-free regulations are weakly enforced. However, limited research explains the psychosocial mechanisms shaping protective intentions among adolescent passive smokers in non-metropolitan settings. This study examines the determinants of protective behavioral intention and actual SHS exposure by extending the Theory of Planned Behavior (TPB) with additional cognitive, emotional, and environmental constructs. By incorporating risk perception, emotional responses, psychological reactions, negative cognition, and environmental exposure, the study offers a context-sensitive behavioral framework for SHS in high-exposure environments. Data were collected through a survey of 140 adolescent non-smokers in Tanjung Selor, Indonesia, who were routinely exposed to cigarette smoke. The model was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results show that emotional responses (Beta = 0.399, $p < 0.001$) and environmental exposure (Beta = 0.401, $p < 0.001$) significantly predict protective behavioral intention, whereas the classical TPB constructs show limited explanatory power. Risk perception exerts strong indirect effects through emotional responses (Beta = 0.678, $p < 0.001$) rather than directly influencing intention. Behavioral intention strongly predicts actual SHS exposure (Beta = 0.507, $p < 0.001$). These findings indicate that adolescents' protective intentions are shaped more by affective and environmental factors than by rational evaluations alone. This study contributes to provide study extends TPB in SHS research and provides empirical guidance for emotion-driven and environment-focused tobacco control interventions in non-metropolitan regions.

1. Introduction

Tobacco use and exposure to second-hand smoke (SHS) remain major public health concerns in Indonesia. The Global Adult Tobacco Survey (GATS) 2021 reports that 34.5% of adults are smokers, equivalent to approximately 70.2 million individuals, with prevalence projected to increase to 38.7% by 2030 (WHO, 2024). Consequently, SHS exposure remains widespread, affecting 74.2% of adults in restaurants and over 40% in public transportation. Such high exposure levels place non-smokers, particularly adolescents, at substantial and preventable health risk (WHO, 2024).

Although the adverse health effects of SHS, including cardiovascular and respiratory diseases, are well established (Safa et al., 2020; Ortiz & Larco, 2021; Chen et al., 2023), a critical gap persists in understanding how psychological mechanisms and environmental constraints interact to shape protective behavior among non-smokers in high-prevalence settings. In Indonesia, nearly 57.8% of adolescents are exposed to SHS, indicating persistent involuntary exposure during a vulnerable developmental stage (Margarini, 2023). Yet, most existing studies focus on determinants of active smoking rather than the behavioral processes underlying passive exposure. Despite national regulations mandating smoke-free areas, enforcement remains inconsistent and compliance is low, particularly in educational and public settings (Putra et al., 2023). This highlights a structural constraint where the mere existence of a policy does not equate to a safe environment, leaving adolescents with limited agency to avoid smoke.

From a theoretical perspective, the Theory of Planned Behavior (TPB) provides a widely accepted framework linking attitude, subjective norm, and perceived behavioral control to intention and behavior (Ajzen, 1991). However, in socially permissive contexts where smoking is normalized and regulatory enforcement is weak, the predictive strength of traditional TPB constructs may be limited (East et al., 2019). This study does not replace TPB; rather, it adopts a TPB extension approach. By integrating affective and contextual constructs, such as risk perception, emotional responses, psychological reactions, negative cognition, and environmental exposure, the model seeks to better capture behavioral dynamics in high-exposure environments (Irawati et al., 2025).

Another theoretical gap concerns the role of indirect affective pathways. Risk perception is often modeled as a direct predictor of intention, yet growing evidence suggests it primarily influences behavior through emotional and cognitive responses (Nurmansyah et al., 2019; Orsal & Ergun, 2021; Tehrani et al., 2022). The mediating roles of these affective processes remain insufficiently examined in SHS research.

Three critical gaps remain in the literature: the limited integration of affective and contextual mechanisms within the TPB framework in SHS research, the insufficient attention to adolescent passive smokers, and the scarcity of evidence from non-metropolitan high-exposure settings. Addressing these gaps, this study develops and empirically tests an extended TPB model to explain protective behavioral intention and actual SHS exposure among adolescent passive smokers in Tanjung Selor, Indonesia. By incorporating affective and environmental determinants into the TPB framework and focusing on a structurally constrained, high-exposure context, this research advances theoretical refinement of health behavior models while providing context-sensitive empirical evidence from a developing non-metropolitan region.

2. Method

2.1. Preliminary Study

The preliminary phase of this study comprised four main stages: problem identification, literature review, field observations, and formulation of research objectives. Problem identification was conducted by examining national tobacco control reports and epidemiological data, particularly in non-metropolitan areas with limited enforcement of smoke-free policies. The literature review focused on recent behavioral and public health studies related to SHS exposure. To contextualize these findings, preliminary field observations were carried out in Tanjung Selor, revealing frequent SHS exposure in public spaces, schools, and social environments, alongside strong social permissiveness toward smoking.

2.2. Data Collection

The study employed a hybrid non-probability sampling design to reach two distinct demographic segments. For the adolescent group (13-16 years old), a purposive sampling approach was used by collaborating with a secondary school in Tanjung Selor. The survey was administered in a supervised

school setting to ensure data integrity and high response rates. For the late adolescence and emerging adulthood group (17-24 years old), data were collected via convenience and snowball sampling through social media platforms and peer networks. This dual-channel approach was designed to capture a broad spectrum of the targeted 'Generation Z' cohort across different life stages (Mulyati et al., 2025; Seemiller & Grace, 2018; Steinberg, 2014). Tanjung Selor is an appropriate research site due to its unique socio-environmental characteristics that differ substantially from large metropolitan areas typically examined in tobacco-control studies. Ethical considerations were strictly maintained for both groups. For participants under 17 years old, the survey followed a school-based administration protocol where teachers acted in loco parentis (in place of parents). For participants aged 17 and above, informed consent was obtained digitally prior to the survey commencement. All data were collected anonymously, and participants were informed of their right to withdraw at any stage, ensuring the study adhered to the principles of voluntary participation.

Eligible participants were adolescents and young adults aged 13–24 years who were non-smokers but regularly exposed to active smokers in their surroundings. A minimum sample size of 140 valid responses was targeted to achieve adequate statistical power. The survey instrument comprised three sections: socio-demographic information, contextual characteristics related to exposure environments, and measurement items for the latent constructs included in the extended TPB. All items were rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Prior to full deployment, the questionnaire underwent content validation to ensure the clarity, relevance, and adequacy of each measurement item. The validated instrument captured key constructs related to attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC), risk perception (RP), psychological reactions (PR), emotion (EM), negative cognition (NC), and environmental conditions (EV). Fig. 1 presents the proposed structural model used for hypothesis testing, in which multiple exogenous constructs are specified to explain behavioral intention (BI) and subsequent actual usage behavior (UB).

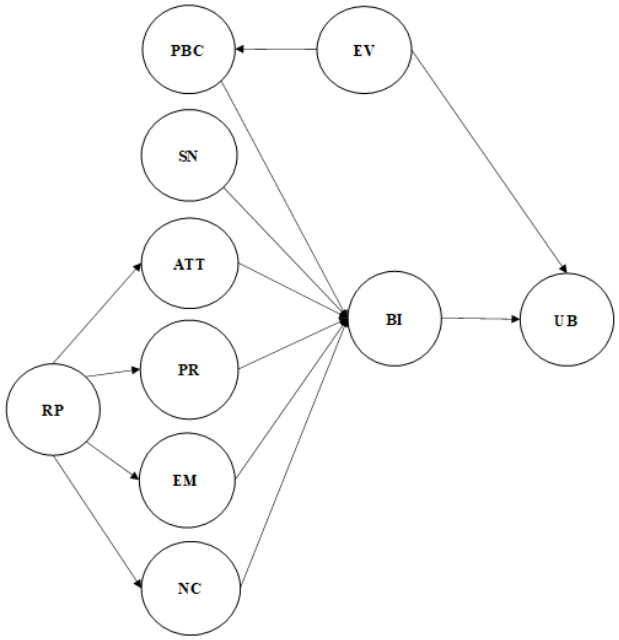

Fig. 1. The conceptual model of the proposed method

2.3. Data Analysis

Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 3.2.6. This method is broadly employed in behavioral and social science research to examine complex associations among latent variables (Ping et al., 2018). The analytical procedure comprised two main stages: (1) assessing the measurement model to verify reliability and

validity, and (2) evaluating the structural model for hypothesis testing and examining the predictive relationships. Constructs were deemed reliable and valid when they achieved the recommended thresholds, including outer loadings, Cronbach's alpha, and composite reliability above 0.70, as well as an Average Variance Extracted (AVE) exceeding 0.50 (Hair et al., 2018). Discriminant validity was confirmed using the Heterotrait-Monotrait (HTMT) criterion, adopting a cut-off value of < 0.90 (Henseler, 2017). Structural model quality was further assessed using the coefficient of determination (R^2), indicating the proportion of variance explained in the endogenous constructs, where values of 0.25 or greater are considered adequate in behavioral research (Hair et al., 2018).

The proposed model advances the TPB by incorporating five supplementary constructs, risk perception, psychological reaction, emotion, negative cognition, and environment, each grounded in relevant theoretical and empirical literature.

H1: Attitude influences behavioral intention toward avoiding second-hand smoke exposure.

H2: Behavioral intention influences use behavior (actual exposure to second-hand smoke).

H3: Emotion influences behavioral intention toward avoiding second-hand smoke exposure.

H4: Environmental exposure influences behavioral intention toward avoiding second-hand smoke exposure.

H5: Environmental exposure influences perceived behavioral control related to avoiding second-hand smoke.

H6: Negative cognition influences behavioral intention toward avoiding second-hand smoke exposure.

H7: Perceived behavioral control influences behavioral intention toward avoiding second-hand smoke exposure.

H8: Psychological reaction influences behavioral intention toward avoiding second-hand smoke exposure.

H9: Risk perception influences attitude toward second-hand smoke exposure.

H10: Risk perception influences emotion related to second-hand smoke exposure.

H11: Risk perception influences negative cognition regarding smoking and smoke-free policies.

H12: Risk perception influences psychological reaction to second-hand smoke exposure.

H13: Subjective norm influences behavioral intention toward avoiding second-hand smoke exposure.

3. Results and Discussion

3.1. Respondent Profile and Descriptive Analysis

The study sample consisted of passive smokers from various administrative areas of Tanjung Selor, selected using a purposive sampling approach to capture adolescents and young adults who do not smoke but are routinely exposed to second-hand smoke in their daily environments. As shown in Table 1, the gender distribution was relatively balanced, with females accounting for 53% of respondents and males 47%, indicating comparable representation across sexes. The age profile was dominated by younger adolescents, with 62% of participants aged under 15 years, followed by those aged over 20 years (24%), 18-20 years (11%), and 15-17 years (3%). This distribution reflects the early onset and widespread nature of second-hand smoke exposure among younger age groups in Tanjung Selor. In terms of educational attainment, the majority of respondents were university students (64%), while 31% had a junior high school background and 6% were enrolled in senior high school, suggesting a heterogeneous educational profile. Overall, the sociodemographic characteristics indicate that the sample captures a diverse group of passive smokers across age, gender, and education levels, providing an adequate basis for examining psychosocial and environmental determinants of second-hand smoke exposure in a non-metropolitan context.

Table 1. Demographic data

Description	Percentage
Gender	
Male	47%
Female	53%
Age	
<15 years	62%
15 – 17 years	3%
18 – 20 years	11%
>20 years	24%
Education	
Junior High School	31%
Senior High School	6%
University	64%

Table 2 shows that exposure to second-hand cigarette smoke among respondents predominantly occurs in public places (53%), highlighting the continued permeability of smoke-free regulations in shared environments. This is followed by exposure at home (29%), suggesting that domestic settings remain a significant source of involuntary smoke exposure, likely due to smoking by family members. Social settings such as hanging out with friends in cafés or coffee shops (13%) also contribute notably, reflecting the normalization of smoking in youth-oriented leisure spaces. In contrast, exposure in schools or colleges (3%), offices (1%), and training places (1%) is relatively limited, possibly indicating better formal regulation or supervision in institutional environments. Overall, these findings underscore that second-hand smoke exposure among adolescents and young adults in Tanjung Selor is driven primarily by weak enforcement in public spaces and limited control over household environments, reinforcing the need for context-specific smoke-free policies and family-based interventions.

Table 2. Primary locations of second-hand smoke exposure among passive smokers

Places Most Frequently Exposed to Cigarette Smoke	Percentage
With Friends / Hanging Out (Cafes / Coffee Shops)	13%
Office	1%
Home	29%
School / College	3%
Training Place	1%
Public Places	53%

3.2. Structural Equation Modeling Analysis

This study employed Structural Equation Modeling (SEM) using the Partial Least Squares (PLS) approach to examine the relationships among psychosocial and contextual factors influencing protective behavioral intentions and actual exposure to second-hand smoke (SHS) among adolescents. The model assessed the effects of attitude, subjective norms, perceived behavioral control, environment, emotion, risk perception, psychological reactions, and negative cognition on behavioral intention and subsequsent exposure outcome. SEM–PLS was selected due to its suitability for theory extension and its robustness in handling complex models with multiple latent constructs. The measurement items for each construct are presented in Table 3.

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Table 3. Measurement items for latent constructs related to second-hand smoke exposure

	Attitude (Attitudes toward exposure to second-hand smoke)
ATT1	I am not particularly bothered by second-hand smoke from other people.
ATT2	I believe that avoiding second-hand smoke is not very important as long as the exposure is not excessive.
ATT3	I feel that exposure to second-hand smoke does not significantly affect my health in a direct way.
	Subjective Norm (Perceived social norms regarding smoking)
SN1	I feel there is strong social pressure to accept smoking behavior.
SN2	I rarely see people confronting smokers in public places.
SN3	People around me generally consider smoking a normal behavior.
	Perceived Behavioural Control (Perceived control over exposure to second-hand smoke)
PB1	I find it difficult to avoid second-hand smoke in public places.
PB2	I find it difficult to ask friends not to smoke near me.
	Risk Perception (Perceived health and environmental risks of second-hand smoke)
RP1	I am aware that second-hand smoke is harmful to my health.
RP2	I am aware that being exposed to second-hand smoke increases the risk of serious diseases.
RP3	I know that cigarette smoke and cigarette butts can pollute the air and environment.
RP4	I know that children and pregnant women are among the most vulnerable to the risks of second-hand smoke.
	Psychological Reaction (Psychological responses to second-hand smoke exposure)
PR1	I often feel dizzy or experience breathing discomfort when exposed to second-hand smoke.
PR2	I feel anxious about the health effects of second-hand smoke.
PR3	I find it difficult to concentrate when I am in a smoky environment.
PR4	I feel nervous or worried when I am in enclosed spaces with smokers.
	Emotion (Emotional responses to smoking and second-hand smoke)
EM1	I feel disturbed by the smell of cigarette smoke.
EM2	I feel sad when I see many adolescents smoking.
EM3	I feel annoyed when people smoke near me.
	Negative Cognition (Negative cognitions / social rationalization of smoking)
NC1	I believe that smoking has become a social habit that is difficult to change.
NC2	I think that smoking regulations are difficult to enforce in society.
NC3	I feel that the government is not strict enough in enforcing smoke-free policies.
NC4	I believe that anti-smoking campaigns are not very effective.
	Environment (Physical and social environmental exposure)
EV1	Schools, campuses, and public places are not completely smoke-free.
EV2	I often see cigarette butts in my surrounding environment.
EV3	I feel that the air in my environment is frequently polluted by cigarette smoke.
EV4	I rarely find public places that are entirely free from cigarette smoke.
	Behavioural Intention (Protective behavioural intentions)
BI1	I intend to keep my distance from people who are smoking.
BI2	I plan to participate in anti-smoking campaigns.
BI3	I want to live in a smoke-free environment.
BI4	I intend to encourage my friends to quit smoking.
	Use Behaviour (Actual exposure to second-hand smoke)
UB1	I am frequently around people who are smoking.
UB2	I often inhale cigarette smoke in public places.
UB3	I have experienced physical discomfort after being exposed to second-hand smoke.

3.3. Measurement Model Evaluation

Convergent validity was evaluated using outer loadings and Average Variance Extracted (AVE). Indicators with standardized loadings greater than 0.70 and AVE values exceeding 0.50 were considered indicative of adequate convergent validity. The results demonstrated that AVE values for all constructs ranged from 0.576 to 0.762, while all indicator loadings were above 0.70, confirming satisfactory convergent validity (Hair et al., 2018). For instance, Behavioral Intention recorded an AVE of 0.576, whereas Risk Perception exhibited a higher AVE of 0.762, with indicator loadings ranging from 0.711 to 0.927, indicating strong construct representation.

Internal consistency reliability was assessed using Cronbach's Alpha and Composite Reliability (CR). Most constructs exceeded the recommended threshold of 0.70, indicating good reliability. However, Subjective Norm (SN) and Perceived Behavioral Control (PBC) showed Cronbach's Alpha values slightly below 0.70. These constructs were retained based on explicit methodological and theoretical considerations. First, this study extends the Theory of Planned Behavior within a specific high-exposure adolescent context, positioning parts of the model as exploratory. In exploratory or context-adaptive research, Cronbach's Alpha values between 0.60 and 0.70 are considered acceptable (Hair et al., 2018). Second, Cronbach's Alpha assumes tau-equivalence and may underestimate reliability in PLS-SEM models with heterogeneous indicators. Accordingly, Composite Reliability, regarded as a more appropriate reliability index in PLS-SEM, was examined.

Importantly, the CR values for all constructs, including SN and PBC, exceeded 0.70, indicating satisfactory internal consistency. Given the adequate CR, strong outer loadings, and AVE values above 0.50, the slightly lower alpha coefficients were interpreted as exploratory tolerance rather than measurement inadequacy. Retaining SN and PBC also preserves the theoretical integrity of the TPB framework. Detailed validity and reliability statistics are presented in Table 4.

Table 4. Convergent validity and internal consistency reliability of measurement constructs

Construct		Outer loading	VIF	Cronbach's alpha	Composite reliability	AVE
ATT	ATT1	0.846	1.248			
	ATT2	0.769	1.659	0.718	0.832	0.623
	ATT3	0.75	1.577			
SN	SN1	0.774	1.261			
	SN2	0.81	1.454	0.693	0.83	0.619
	SN3	0.777	1.399			
PBC	PBC1	0.915	1.267	0.629	0.837	0.722
	PBC2	0.779	1.267			
RP	RP1	0.866	2.487			
	RP2	0.924	4.039	0.894	0.927	0.762
	RP3	0.927	4.077			
	RP4	0.764	1.690			
PR	PR1	0.8	1.947			
	PR2	0.864	2.157	0.868	0.91	0.717
	PR3	0.874	2.445			
	PR4	0.846	2.149			
EM	EM1	0.903	2.611			
	EM2	0.786	1.447	0.82	0.894	0.738
	EM3	0.884	2.523			
NC	NC1	0.708	1.688			
	NC2	0.874	2.836	0.81	0.875	0.64
	NC3	0.877	2.406			
	NC4	0.723	1.378			
EV	EV1	0.758	1.518			
	EV2	0.769	1.629	0.789	0.863	0.612
	EV3	0.808	1.645			
	EV4	0.792	1.600			
BI	BI1	0.797	1.573			
	BI2	0.806	1.611	0.753	0.844	0.576
	BI3	0.717	1.345			
	BI4	0.711	1.352			
UB	UB1	0.726	1.352			
	UB2	0.841	1.494	0.714	0.838	0.634
	UB3	0.817	1.382			

Discriminant validity was further assessed using the HTMT ratio. As presented in Table 5, all HTMT values were below the recommended threshold of 0.90, indicating that each construct is empirically distinct (Henseler, 2017). To enhance methodological rigor, bootstrapping procedures (5,000 resamples) were conducted to generate bias-corrected and accelerated (BCA) 95% confidence intervals for the HTMT estimates. The results showed that none of the confidence intervals included the value of 1.00, thereby providing additional statistical evidence of discriminant validity. The upper bounds of all intervals remained below the critical value, confirming that the constructs are sufficiently differentiated at the empirical level. These findings strengthen the robustness of the measurement model and indicate that the latent variables capture conceptually distinct dimensions related to second-hand smoke exposure, psychosocial reactions, and behavioral intentions among adolescents.

Table 5. HTMT for discriminant validity

	ATT	BI	EM	EV	NC	PBC	PR	RP	SN	UB
ATT										
BI	0.114									
EM	0.358	0.798								
EV	0.224	0.772	0.549							
NC	0.155	0.571	0.670	0.730						
PBC	0.379	0.402	0.320	0.586	0.567					
PR	0.123	0.676	0.799	0.549	0.634	0.447				
RP	0.164	0.562	0.785	0.542	0.742	0.440	0.676			
SN	0.382	0.346	0.362	0.440	0.494	0.771	0.407	0.473		
UB	0.196	0.667	0.534	0.849	0.688	0.556	0.563	0.464	0.388	

3.4. Structural Model and Hypothesis Testing

Hypothesis testing was performed by examining path coefficients, t-statistics, and p-values using a significance threshold of $p < 0.05$. As summarized in Table 6, the results indicate that 6 out of 13 hypothesized relationships were statistically supported, revealing a nuanced pattern of determinants underlying adolescents' protective behavioral intentions toward second-hand smoke exposure. Behavioral intention showed a strong and significant association with actual exposure outcome (H2: BI→UB; $\beta = 0.507$, $p < 0.001$), confirming the central role of intention in explaining real-life SHS exposure. Notably, emotional responses (H3: EM→BI; $\beta = 0.399$, $p < 0.001$) and environmental conditions (H4: EV→BI; $\beta = 0.401$, $p < 0.001$) emerged as significant predictors of protective behavioral intention. These findings suggest that affective reactions (e.g., feeling disturbed or annoyed by smoke) and adverse environmental contexts (e.g., smoke-filled public spaces) are more influential in shaping intentions than rational evaluations alone.

Environmental exposure also showed a significant relationship with perceived behavioral control (H5: EV→PBC; $\beta = 0.439$, $p < 0.001$), indicating that more pervasive smoke-filled environments heighten adolescents' perceptions of difficulty in avoiding SHS. In addition, risk perception played a pivotal upstream role, exerting strong effects on emotional responses (H10: RP→EM; $\beta = 0.678$, $p < 0.001$), negative cognition/social rationalization (H11: RP→NC; $\beta = 0.639$, $p < 0.001$), and psychological reactions (H12: RP→PR; $\beta = 0.609$, $p < 0.001$). These results highlight that awareness of SHS risks primarily operates through affective and cognitive pathways rather than directly influencing intentions. In contrast, several classical TPB paths were not supported. Attitude toward SHS exposure (H1), perceived behavioral control (H7), and subjective norms (H13) did not significantly predict behavioral intention, suggesting a limited role of rational and normative considerations in contexts where smoking is socially normalized. Similarly, negative cognition regarding regulations (H6), psychological reactions (H8), and the direct path from risk perception to attitude (H9) were not statistically significant. Overall, the hypothesis testing results demonstrate that protective intentions against second-hand smoke among adolescents are driven predominantly by emotional and environmental mechanisms, with risk perception acting indirectly through affective and cognitive responses.

Table 6. Structural model path coefficients and hypothesis testing results

Hypothesis		Sample mean (M)	Standard deviation (STDEV)	T statistics	P values	Results
H1	ATT → BI	-0.007	0.070	0.037	0.970	x
H2	BI → UB	0.507	0.071	6.954	0.000	√
H3	EM → BI	0.399	0.100	3.949	0.000	√
H4	EV → BI	0.401	0.112	3.632	0.000	√
H5	EV → PBC	0.439	0.074	5.811	0.000	√
H6	NC → BI	-0.062	0.113	0.587	0.557	x
H7	PBC → BI	0.001	0.077	0.062	0.951	x
H8	PR → BI	0.136	0.094	1.388	0.165	x
H9	RP → ATT	-0.162	0.087	1.628	0.104	x
H10	RP → EM	0.678	0.069	9.766	0.000	√
H11	RP → NC	0.639	0.061	10.426	0.000	√
H12	RP → PR	0.609	0.080	7.551	0.000	√
H13	SN → BI	-0.008	0.077	0.165	0.869	x

This study examined an extended TPB model incorporating additional affective and cognitive constructs including emotion, risk perception, psychological reaction, negative cognition, and environment to understand protective behavioral intentions and actual exposure to second-hand smoke (SHS) among adolescents. As seen in Table 6, the model extension aligns with contemporary literature demonstrating that protection against SHS exposure is influenced not only by rational factors (attitudes, norms, control) but also by emotional and risk perception factors. Of the 13 hypotheses tested, 6 showed significant effects (H2, H3, H4, H5, H10, H11, H12), while 7 were non-significant (H1, H6, H7, H8, H9, H13). These findings reveal complex psychosocial dynamics and several results that contradict conventional health behavior theory, particularly regarding the limited role of classical TPB components in contexts characterized by high involuntary exposure and weak policy enforcement. The pattern of results indicates that emotional variables, environmental conditions, and risk perception play central roles, while classical TPB components (attitude, subjective norm, perceived behavioral control) are relatively weak in predicting behavioral intentions.

3.4.1. Influence of Behavioral Intention on Use Behavioral

Most notably, behavioral intention demonstrated a strong positive effect on actual exposure outcome. This counterintuitive finding requires careful interpretation: the use behavior construct measured actual exposure experienced (e.g., "I am frequently around people who are smoking") rather than protective behaviors enacted. Thus, adolescents with higher protective intentions are paradoxically those who experience more frequent SHS exposure in daily life. This pattern reflects a reactive formation of protective intentions in response to unavoidable environmental exposure, consistent with psychological reactance theory. Although adolescents possess strong intentions to avoid cigarette smoke, their actual control over their environment remains severely limited, particularly when family members smoke at home, peers smoke, or public facilities lack adequate smoke-free areas. This finding aligns with the non-significant effect of PBC on intentions (H7), indicating that adolescents recognize their extremely limited behavioral control and thus perceived control fails to shape protective intentions (Sheeran, 2021; Rhodes et al., 2021).

3.4.2. Influence of Emotion on Behavioral Intention

The strong positive effect of emotional responses on protective intentions demonstrates that feelings of disturbance, sadness, or annoyance toward smoking behavior serve as primary drivers of protective intentions. This finding indicates that affective pathways dominate over rational cognitive pathways in shaping adolescent protective intentions, consistent with the affect heuristic theory (Slovic et al., 2007), and risk-as-feelings hypothesis (Loewenstein, 2001). Health psychology research demonstrates that emotional reactions often exert stronger influence than attitudes in forming preventive behavioral intentions, particularly among adolescents whose limbic systems develop

earlier than prefrontal cortical regions responsible for rational decision-making (Peters et al., 2019). From a practical perspective, this finding carries important implications for intervention design: health campaigns targeting adolescents should emphasize emotional response generation through testimonials, powerful visuals, and personal narratives rather than relying solely on statistical presentations and factual information about smoking hazards (Dillard et al., 2012).

3.4.3. Influence of Environment on Behavioral Intention

Physical and social environmental factors (schools/public places not smoke-free, frequent visibility of cigarette butts, air polluted by cigarette smoke) significantly influenced protective intentions. Paradoxically, exposure to smoke-laden environments increased respondents' awareness and desire to live in smoke-free environments, demonstrating a reactive intention effect whereby negative environmental pressure triggers rather than suppresses protective intentions. However, as indicated by the positive correlation between intentions and use behavior (H2), the capacity to actualize these intentions into protective behaviors remains severely constrained. This creates a paradoxical situation: deteriorating environments motivate adolescents to protect themselves, yet these same environments prevent them from doing so effectively (Jr et al., 2000; Li et al., 2020). This finding extends environmental press theory and risk compensation models, while highlighting the critical importance of structural interventions that modify environmental conditions rather than solely targeting individual-level factors (Jakubowska et al., 2024; Pisinger et al., 2017).

3.4.4. Influence of Environment on Perceived Behavioral Control

Environment exerted a strong positive effect on perceived behavioral control. However, careful interpretation of the PBC measurement reveals that items focused on difficulty avoiding exposure (e.g., "I find it difficult to avoid second-hand smoke in public places"; "I find it difficult to ask friends not to smoke near me"). Thus, higher PBC scores actually indicate greater perceived difficulty or lower control. The positive and significant hypothesis result therefore demonstrates that smoke-pervaded environments make individuals feel unable to avoid exposure or confront smokers, thereby weakening behavioral control. This finding aligns with research on smoke-free area policies in Southeast Asia in Byron et al. (2019); Septiono et al. (2020) and supports learned helplessness theory in Maier (1976), whereby repeated exposure to uncontrollable situations produces perceptions of lacking control over outcomes. This condition is concerning because learned helplessness can reduce motivation to attempt protective behaviors, creating a negative cycle of exposure and passivity (Orbell & Verplanken, 2018).

3.4.5. Influence of Risk Perception on Emotion

Risk perception (awareness of hazards, serious disease risks, environmental pollution, vulnerability of children and pregnant women) exerted the strongest effect in the model on emotion. This finding supports the cognitive appraisal theory of emotion, which posits that emotions result from cognitive appraisal processes of stimuli. When adolescents appraise cigarette smoke as a serious health threat, this cognitive assessment triggers emotional responses including annoyance, disturbance, and sadness. In practical terms, demonstrates that education about SHS health risks can effectively generate adolescent emotional responses, which in turn shape protective intentions through the mediation pathway: Risk Perception→Emotion→Protective Intention (Brewer et al., 2016; Linden, 2021).

3.4.6. Influence of Risk Perception on Negative Cognition

Risk perception also strongly influenced negative cognition/social rationalization. This finding reveals an intriguing paradox: as adolescents increasingly recognize SHS risks, they simultaneously become more pessimistic about possibilities for social change. Although adolescents believe cigarette smoke is dangerous (high personal risk perception), they lack confidence that society and government can address this problem (low collective efficacy). In Indonesian contexts where smoke-free area implementation varies widely and remains inconsistent, risk-aware adolescents may have observed

that risk awareness fails to translate into actual policy changes or social behavioral shifts, thereby developing skepticism (Kusuma et al., 2019; Ayu et al., 2020). This finding carries serious implications: campaigns focusing solely on raising risk awareness without demonstrating possibilities for concrete change may paradoxically increase fatalism and reduce motivation for collective action (Peters et al., 2019).

3.4.7. Influence of Risk Perception on Psychological Reaction

The strong effect of risk perception on psychological reactions indicates that adolescents who view second-hand smoke as harmful tend to become more vigilant toward bodily sensations and more likely to interpret them as signs of threat. This pattern is consistent with theories of symptom perception and the nocebo mechanism, in which negative expectations amplify adverse subjective experiences (Vambheim & Flaten, 2017). The pathway also reflects dual-process models, suggesting that risk perception operates primarily through affective and reactive channels rather than through attitudes or intentions. However, the absence of a significant link between psychological reactions and protective intentions may signal a normalization of discomfort. In environments with persistent smoke exposure, adolescents may perceive distress as unavoidable, reducing its motivational impact.

3.4.8. Non-Significant Relationships

Several findings challenge core assumptions of the Theory of Planned Behavior (TPB). Attitude, subjective norm, and perceived behavioral control (PBC) did not significantly predict protective intentions toward second-hand smoke (SHS). In high-prevalence smoking environments, personal attitudes may lose predictive power because SHS exposure is culturally normalized (Hitchman et al., 2010). When exposure is perceived as an unavoidable part of daily life, favorable or unfavorable evaluations do not necessarily translate into intention.

Similarly, subjective norms were not associated with intention, suggesting that in socially permissive smoking cultures, normative pressure lacks variability and therefore limited explanatory capacity. This aligns with evidence from Indonesia and other Asian contexts where descriptive norms fail to predict avoidance behavior under conditions of widespread social acceptance. Negative cognition regarding regulations and policies showed no significant effect on intentions. Skeptical attitudes toward government or anti-smoking campaign effectiveness do not automatically reduce personal intentions, indicating that individuals compartmentalize macro-level policy evaluations from micro-level behavioral decisions. In other words, adolescents can simultaneously hold two seemingly contradictory beliefs: (1) they believe social interventions are ineffective and societal smoking behavior change is difficult, yet (2) they maintain intentions to protect themselves from SHS exposure.

The non-significant role of PBC is theoretically notable. In contexts where environmental exposure is pervasive, perceived control may be uniformly low, rendering it ineffective as a differentiating predictor. This finding supports critiques that TPB may have limited applicability in situations of involuntary health risk exposure constrained by structural factors (Conner & Norman, 2022). Intention formation appears to occur despite low perceived control, indicating that motivational processes may operate independently of feasibility perceptions in constrained environments.

Negative cognition toward policies and psychological reactions also showed no direct effects on intention, suggesting that macro-level skepticism and physical discomfort do not automatically translate into protective motivation. Instead, affective processes appear more influential than purely cognitive evaluations, consistent with research emphasizing emotional pathways in health behavior (Orbell & Verplanken, 2018; Brewer et al., 2016).

Overall, these findings extend TPB by demonstrating that in structurally constrained, pro-smoking environments, classical cognitive predictors weaken, while affective mechanisms play a more central role. From a policy perspective, interventions targeting emotional engagement and structural smoke-free enforcement may be more effective than approaches relying solely on attitude change or informational campaigns. The cross-sectional nature of this study precludes causal inferences, and the reliance on self-reported data may introduce recall bias. Additionally, the findings

are specific to the sociocultural landscape of Tanjung Selor. Future research should employ longitudinal designs to track the evolution of risk perception and emotional responses, particularly following smoke-free policy implementations. Experimental studies comparing emotion-based versus cognition-based interventions are recommended to refine public health strategies for Gen Z in developing nations.

4. Conclusion

This study examined the determinants of adolescents' protective intentions and behaviors regarding second-hand smoke (SHS) exposure using an extended TPB framework. The findings indicate that traditional TPB components, attitude, subjective norm, and perceived behavioral control, did not significantly predict protective intentions. Instead, emotional responses and environmental conditions played a more prominent role in shaping intention formation. Risk perception influenced protective intentions indirectly through affective and psychological pathways. Protective intention, in turn, was significantly associated with protective behavior. These results suggest that, in high-exposure contexts where smoking is socially normalized, affective and contextual factors are more salient predictors of protective intention than conventional cognitive components. This study is limited by its cross-sectional design and its focus on a single geographic area, which restrict causal interpretation and generalizability. Future research should employ longitudinal or experimental designs to clarify causal pathways, include more diverse populations, and incorporate objective environmental or policy-related measures to strengthen external validity.

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