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The Influence of Knowledge of Respiratory Diseases and Pulmonary Function Risks on Malaysian Adults' Smoking Cessation: A Moderated Model of Socio-Demographic Factors

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Abstract
This study explores the influence of knowledge of respiratory diseases and perceived pulmonary function risks (PFR) on smoking cessation attitudes among adults in Klang Valley, Malaysia. Utilizing a quantitative research design and structured questionnaires, data were collected from a sample of 286 participants and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results indicate that PFR significantly and positively predicts smoking cessation attitudes, while KRD demonstrates a significant but negative association. These findings suggest that although awareness of respiratory diseases is essential, it may not be sufficient to encourage smoking cessation without the presence of motivational or supportive elements. Furthermore, socio-demographic factors, such as age, education level, and income, moderate the effects of KRD and PFR on cessation attitudes, enhancing the explanatory power of the model. Gender, however, showed no significant moderating effect. The study concludes that effective smoking cessation interventions should not only increase knowledge but also bolster self-efficacy and be tailored to demographic contexts. These insights contribute to the development of more targeted, effective public health strategies aimed at reducing smoking prevalence and promoting cessation efforts in diverse populations.
Keywords: *Smoking cessation, Knowledge of respiratory diseases, Pulmonary function risk, Socio-demographic factors, Smoking attitudes*

1. INTRODUCTION

Tobacco use is one of the most preventable causes of morbidity and mortality worldwide, responsible for over 8 million deaths annually, primarily due to cardiovascular and respiratory diseases (World Health Organization [WHO], 2020). Despite global tobacco control efforts, smoking prevalence remains persistent in many regions, particularly in low- and middle-income countries. Malaysia, a middle-income Southeast Asian nation, has shown fluctuating trends in smoking behavior, with recent surveys indicating high levels of tobacco use among certain socio-demographic groups (Yusoff et al., 2022). This situation calls for targeted interventions that move beyond generic health warnings to address the deeper cognitive, behavioral, and socio-cultural factors that drive smoking behavior and impede cessation. One crucial factor influencing smoking cessation is the individual's knowledge of smoking-related health risks, particularly concerning respiratory diseases such as chronic obstructive pulmonary disease (COPD), asthma, and bronchitis (Celebi et al., 2021). Knowledge about how smoking impairs pulmonary function and contributes to respiratory morbidity can potentially increase the perceived severity and susceptibility to illness, which are critical constructs in the Health Belief Model (HBM) (Rosenstock et al., 1988). Similarly, the Theory of Planned Behavior (TPB) suggests that intention to quit smoking is influenced by attitudes formed through knowledge and beliefs, along with perceived behavioral control and social norms (Ajzen, 1991). Thus, increasing awareness and understanding of respiratory diseases may enhance motivation to quit.

However, knowledge alone does not always translate into behavior change. Numerous studies have shown that socio-demographic variables such as age, education, income, and gender significantly influence both smoking behavior and cessation outcomes (Amalia et al., 2019; Assari & Bazargan, 2019). Individuals with higher educational attainment are generally more responsive to health education, as they possess better health literacy and cognitive processing skills necessary to interpret risk information (Cutler & Lleras-Muney, 2019). Conversely, those with lower income levels often face greater structural and psychosocial barriers, including stress, limited access to cessation resources, and normalized smoking behavior in their social circles (Pampel et al., 2020).

Moreover, empirical evidence suggests that interventions that do not account for such socio-demographic disparities may inadvertently widen health inequalities (Bafunno et al., 2020; Lederer et al., 2022). A

growing body of literature has called for the adoption of moderated models that explore how socio-demographic variables interact with cognitive predictors to influence behavioral outcomes (Hair et al., 2019). In the context of smoking cessation, this means examining whether knowledge of respiratory diseases and perceived pulmonary function risks have differential effects across socio-demographic groups. For example, while knowledge of COPD risks may strongly discourage smoking among older adults or individuals with chronic illnesses, it might have a weaker effect among younger adults who perceive themselves as less vulnerable (Choi et al., 2023; Herath et al., 2025). This study seeks to bridge these gaps by examining the influence of knowledge of respiratory diseases (KRD) and PFR on smoking cessation behavior through a moderated structural model. Specifically, the research aims to: (1) assess the direct effects of KRD and PFR on smoking cessation intentions and behaviors; (2) evaluate how socio-demographic factors such as age, gender, education, and income moderate these relationships; and (3) provide empirical evidence to guide the design of more inclusive, equity-driven smoking cessation interventions. The study employs Partial Least Squares Structural Equation Modeling (PLS-SEM), a robust multivariate analysis technique suitable for exploring complex models with latent variables and moderation effects (Hair et al., 2017; Henseler et al., 2015).

By focusing on socio-cognitive and demographic predictors of smoking cessation, this research contributes to the growing discourse on precision public health, an approach that tailors interventions based on contextual and individual-level characteristics. The findings are expected to inform policymakers, public health practitioners, and health educators in designing more effective, culturally sensitive smoking cessation programs that address not just the knowledge gaps but also the socio-economic barriers faced by different population segments.

2. LITERATURE REVIEW

Smoking cessation research has long been grounded in cognitive-behavioral theories that emphasize the role of knowledge and risk perception in behavioral change. The HBM proposes that health behaviors are driven by individuals perceived susceptibility to illness and perceived severity of health threats, balanced against perceived benefits and barriers (Rosenstock et al., 1988). These constructs highlight the importance of knowledge about specific health risks, such as chronic respiratory diseases and diminished lung function, in motivating quitting behavior. In parallel, the TPB posits that an individual's intention to quit is influenced by their attitude toward smoking, social norms, and perceived behavioral control (Ajzen, 1991). Awareness of respiratory disease and pulmonary risk both enhances negative attitudes toward smoking and reinforces perceived control by emphasizing the immediate consequences of continued use (Bandura, 1986; Sheeran et al., 2021).

Empirical studies substantiate these theoretical links. Celebi et al. (2021) demonstrated that greater knowledge of smoking-induced diseases strongly predicted the intention to quit, especially among those with firsthand experience of respiratory symptoms. Cobos-Campos et al. (2023) further confirmed this by showing improved cessation rates when digital interventions emphasized pulmonary risk content in a culturally sensitive manner. Adut (2023) found that personalized text-message cessation programs, tailored by respiratory health knowledge, outperformed generic messages, highlighting the importance of message relevance and individual risk awareness. Perceived PFR independently influence cessation behavior. Akter et al. (2023) observed in their systematic review that individuals cognizant of their impaired lung capacity were significantly more likely to attempt quitting, with respiratory concerns serving as strong behavior change motivators. Public policy interventions, such as smoking bans in eateries, reinforce PFR by associating smoking with tangible health and social consequences, thereby strengthening self-efficacy and social support for cessation (Ahmad & Ng, 2022; Ahmed et al., 2020).

However, these cognitive mechanisms do not operate uniformly across all population segments. Socio-demographic variables such as education, income, age, and gender significantly shape how individuals interpret and act upon health-related knowledge and risk perceptions. Higher education often correlates with greater health literacy and information-processing skills, thereby amplifying the impact of risk awareness on quitting behavior (Cutler & Lleras-Muney, 2019; Amalia et al., 2019). In contrast, individuals with lower socioeconomic status may face external barriers, such as stress, limited access to support systems, and entrenched social norms, which diminish the impact of health knowledge alone (Pampel et al., 2020; Lederer et al., 2022). Age and gender also play pivotal roles. Choi et al. (2023) found that older smokers reported higher perceived pulmonary risk and greater intention to quit, compared to younger individuals who often downplayed long-term health threats. Herath et al. (2025) showed similar patterns among Sri Lankan adults, highlighting the moderating effect of age. Gender differences are

nuanced: while women may be more receptive to health messaging, they may also face greater societal barriers and stigma around quitting, which can impede their ability to act even when aware of risk (Ozbay et al., 2020; Smith et al., 2020).

Importantly, interventions that fail to consider these socio-demographic differences risk exacerbating health disparities. Bafunno et al. (2020) demonstrated that untargeted cessation campaigns may disproportionately benefit individuals with higher social capital, while leaving disadvantaged groups behind. This gap has spurred interest in moderated models that test how demographic factors influence the effectiveness of knowledge-based interventions (Hair et al., 2019; Henseler et al., 2015). Initial empirical evidence supports such an approach: Adut (2023) reported stronger text-message cessation effects among participants with higher educational attainment, whereas Akter et al. (2023) noted age-dependent differences in responsiveness to pulmonary risk messaging.

Thus, the current study builds on this growing body of evidence by formally examining moderated relationships using Partial Least Squares Structural Equation Modeling (PLS-SEM). The model tests both direct effects of KRD and perceived PFR on smoking cessation, and how these effects vary by socio-demographic factors, including education, income, age, and gender. This approach addresses a clear research gap: while knowledge and risk perceptions are recognized as vital, their translation into behavior is heavily moderated by demographic context. By providing empirical evidence from the socio-culturally diverse Klang Valley, this study aims to inform more equitable and tailored smoking cessation interventions.

3. METHODOLOGY

This study employs a quantitative research design to examine the influence of KRD and perceived PFR on smoking cessation among adults in Klang Valley, Malaysia. The quantitative approach enables objective measurement and statistical analysis of the associations between latent constructs and observed behaviors. This design is particularly appropriate for identifying the moderating role of socio-demographic factors, such as age, gender, education level, and income, on the relationship between health knowledge and smoking cessation outcomes. Structured questionnaires were selected as the primary data collection tool due to their standardization and suitability for large-scale population studies. The items were adapted from established instruments, refined through expert consultation, and pre-tested to ensure clarity, validity, and reliability (Wang et al., 2023; Ghani & Asghar, 2024).

The target population included residents of Klang Valley aged 18 years and above, encompassing both current and former smokers. This demographic spread was intended to capture diverse cessation experiences and behaviors. To ensure proportional representation of socio-demographic characteristics, a stratified random sampling technique was used, segmenting participants by gender, age group, and socio-economic status (Wihatno et al., 2025; Kamaruddin et al., 2022). The sample size of 400 was determined using Cochran's formula for large populations at a 95% confidence level and a 5% margin of error, with an allowance for potential non-responses (Cochran, 1977). Eligibility criteria included Malaysian residency in Klang Valley, age ≥18, and voluntary participation. Participants with cognitive impairments or residing outside the study area were excluded to ensure the integrity of the responses (Valluri, 2025; DeCormier Plosky et al., 2022).

Data collection was conducted through a combination of online surveys and in-person distribution at community health centers and public spaces to optimize response rates. The questionnaire was piloted on a subsample to assess understandability and functionality, resulting in iterative revisions before full deployment (Mohd Jamil et al., 2022). Ethical approval was secured prior to data collection, and all participants provided informed consent. Confidentiality was maintained in line with ethical research standards (Shahid et al., 2022). Statistical analysis was conducted using IBM SPSS 27 and SmartPLS 4.0. Descriptive statistics summarized demographic data and cessation status, while inferential tests (chi-square, independent t-tests) examined differences across socio-demographic groups. To assess multivariate relationships and test hypothesized paths, Partial Least Squares Structural Equation Modeling (PLS-SEM) was utilized. This method is well-suited for examining complex relationships involving latent variables and small-to-medium sample sizes (Hair et al., 2017; Kline, 2023). Measurement models were evaluated based on factor loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). Loadings above 0.5, CR and alpha above 0.7, and AVE above 0.5 indicated satisfactory construct validity and reliability (Pallant, 2020; Henseler et al., 2015).

Normality was tested using Shapiro-Wilk, skewness, and kurtosis statistics, informing the selection of parametric or non-parametric tests where needed (Finocchio et al., 2021). Multicollinearity was assessed

via the Variance Inflation Factor (VIF), ensuring all indicators fell below the acceptable threshold of 10 (Akintunde et al., 2021). Moderation analysis was performed through interaction terms to explore the impact of socio-demographic variables on the relationship between KRD, PFR, and smoking cessation outcomes. Finally, model fit and predictive accuracy were evaluated using indices such as R^2, path coefficients, t-values, and p-values, with bootstrapping (5,000 resamples) employed for significance testing (Hair et al., 2019; Shmueli, 2010). Through this robust methodological framework, the study aims to provide empirical insights into how health knowledge and demographic contexts interact to shape smoking cessation behaviors, ultimately informing more effective and personalized tobacco control strategies in Malaysia.

4. FINDINGS

Descriptive and normality analyses were conducted on the dataset comprising 286 participants to evaluate the distribution of constructs related to smoking cessation. As shown in Table 1, the KRD construct exhibited mild positive skewness (0.179) and low kurtosis (0.198), indicating a near-normal distribution. Perceived PFR demonstrated moderate negative skewness (–0.808) and slightly elevated kurtosis (0.711), reflecting a left-tailed distribution. Smoking cessation attitudes (SCA) showed slight negative skewness (–0.423) and lower kurtosis (–1.007), suggesting a platykurtic distribution.

Table 1 : Normality test

Construct	N	Skewness	Kurtosis
KRD	286	0.179	0.198
PFR	286	-0.808	0.711
SCA	286	-0.423	-1.007

KDR: Knowledge of respiratory diseases; PFR: Pulmonary function risks; SCA: Smoking cessation.

These values fall within the acceptable range (±2), supporting the assumption of normality for further parametric analysis (Pallant, 2020; Shie et al., 2017). The structural equation modeling results indicated that the measurement model met reliability and validity thresholds. Constructs showed strong internal consistency, with Cronbach's alpha and composite reliability values exceeding .70 and AVE values above .50 (Table 4). Discriminant validity was verified through the Fornell-Larcker criterion and HTMT ratio, confirming conceptual distinctiveness between constructs (Henseler et al., 2015). In the structural model, knowledge of respiratory diseases significantly predicted smoking cessation attitudes ($\beta = 0.686$, $t = 17.857$, $p < 0.001$), while perceived pulmonary function risks had a significant negative effect ($\beta = –0.204$, $t = 3.104$, $p = 0.002$). The model explained 41.1% of the variance in cessation attitudes ($R^2 = 0.411$), indicating robust explanatory power.

Moderating effects of socio-demographic factors were also significant in several pathways. Education and age positively moderated the effects of both KRD and PFR, while income showed mixed effects. Gender was not a significant moderator. Descriptive analysis was conducted to understand participants' general perceptions and attitudes toward the study constructs. As presented in Table 2, the mean score for KRD was 3.50 (SD = 0.51), indicating a moderately high awareness level among participants. Perceived PFR recorded the highest mean score of 3.80 (SD = 0.49), suggesting a strong perceived risk of pulmonary dysfunction. Meanwhile, the mean for SCA was 3.44 (SD = 0.96), reflecting moderate support for smoking cessation efforts within the sampled population.

Table 2 : Descriptive Analysis

Construct	N	Mean	Std. Deviation
KRD	286	3.5005	0.50924
PFR	286	3.7955	0.48849
SCA	286	3.4413	0.95578

KDR: Knowledge of respiratory diseases; PFR: Pulmonary function risks; SCA: Smoking cessation.

These descriptive values suggest an overall trend of moderate to high health awareness and risk perception regarding smoking-related outcomes, which underpins the potential influence of health literacy and risk cognition on smoking cessation behaviors.

Figure 1 illustrates the initial measurement model assessing the relationship between KRD and Perceived PFR on SCA. The path diagram reveals the outer loadings of individual items under each latent construct. For KRD, item loadings vary significantly, with several items (e.g., KRD1 = -0.287, KRD2 = -0.343)

showing negative or weak contributions, suggesting potential issues with construct validity in the initial scale design. In contrast, KRD5 (0.834) shows a strong positive contribution to the latent construct. For the PFR construct, item loadings also demonstrate variability, with PFR4 (0.754) and PFR6 (0.550) indicating substantial contributions, while PFR3 (-0.186) weakly reflects the construct. The SCA construct demonstrates overall stronger and more consistent item loadings, such as SCA1 (0.832), SCA2 (0.834), and SCA4 (0.783), indicating a robust measurement of smoking cessation attitudes. Overall, the initial model suggests that while SCA is reliably measured, some items under KRD and PFR may require refinement or removal in subsequent model evaluations to improve construct reliability and convergent validity. This evaluation sets the foundation for model purification and optimization in the final measurement model.

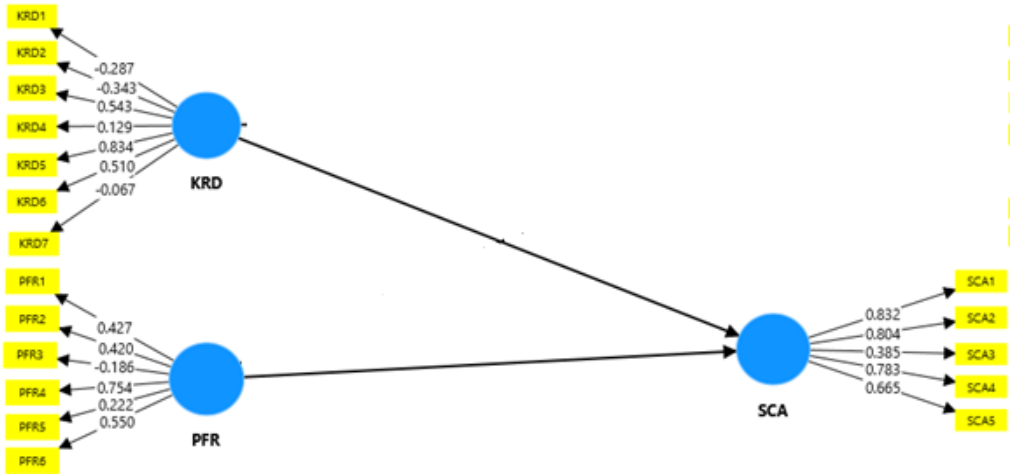

Figure 1 : Initial Model measurements

Table 3 presents the results of the initial measurement model for the constructs KRD, PFR, and SCA. The KRD construct shows poor internal consistency with a Cronbach's alpha of 0.397, CR of 0.239, and AVE of 0.210, well below acceptable thresholds. These low values suggest significant measurement issues, which are corroborated by weak and even negative item loadings, such as KRD1 (-0.287) and KRD2 (-0.343). Although KRD5 demonstrates a strong loading (0.834), the inconsistency across items undermines the construct's reliability and validity. Similarly, the PFR construct exhibits low reliability, with a Cronbach's alpha of 0.175, CR of 0.505, and AVE of 0.219. Several items under this construct fall below the acceptable loading threshold of 0.50, including PFR3 (-0.186) and PFR5 (0.222). These findings indicate a need to revise or eliminate underperforming items to improve measurement quality.
In contrast, the SCA construct displays much better psychometric properties. It yields a Cronbach's alpha of 0.740, composite reliability of 0.830, and AVE of 0.508, all meeting the recommended benchmarks for construct validity. Most items in the SCA construct, such as SCA1 (0.832) and SCA4 (0.783), show strong item loadings, supporting the reliability of this construct in measuring smoking cessation attitudes. These initial findings point to the necessity for model refinement, especially in the KRD and PFR constructs, before proceeding to structural model analysis. Improvements could include the removal of poorly performing items and re-evaluation through Confirmatory Factor Analysis (CFA) in the final model.

Table 3 : Initial Model Measurements

Construct	Items	Loading	Cronbach's alpha	Composite reliability	(AVE)
	KRD1	-0.287			
	KRD2	-0.343			
	KRD3	0.543			
	KRD4	0.129	0.397	0.239	0.210
	KRD5	0.834			
	KRD6	0.510			
	KRD7	-0.067			
	PFR1	0.427			
	PFR2	0.420	0.175	0.505	0.219

	PFR3	-0.186			
	PFR4	0.754			
	PFR5	0.222			
	PFR6	0.550			
	SCA1	0.832			
	SCA2	0.804			
	SCA3	0.385	0.740	0.830	0.508
	SCA4	0.783			
	SCA5	0.665			

KDR: Knowledge of respiratory diseases; PFR: Pulmonary function risks; SCA: Smoking cessation.

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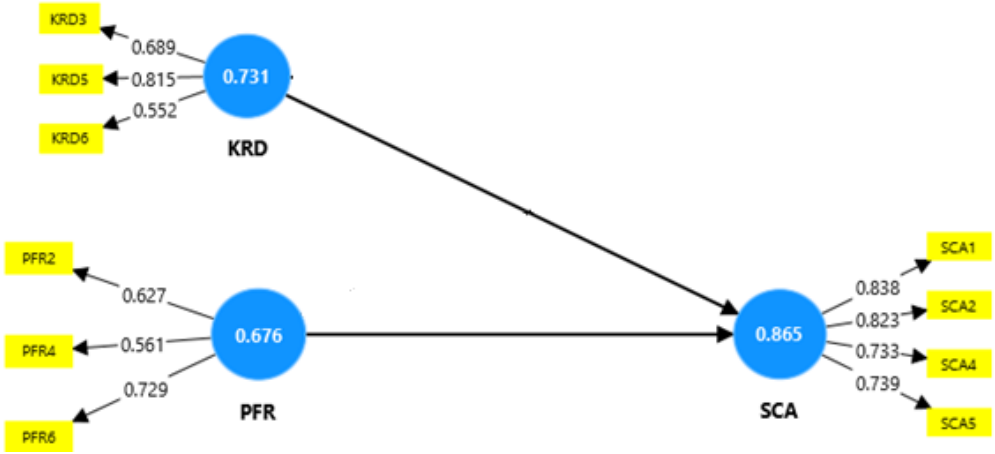

Figure 2 : Final Model measurements

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internal consistency. The final model thus provides a sound foundation for proceeding with SEM to test hypothesized relationships between KRD, PFR, and smoking cessation attitudes. A comparison between the initial and final measurement models reveals notable improvements in the model's psychometric robustness. In the initial model, the constructs for KRD and PFR suffered from low reliability and poor factor loadings. Specifically, the Cronbach's alpha values for KRD (0.397) and PFR (0.175) were well below the acceptable threshold of 0.60, indicating insufficient internal consistency. Many of the individual items, such as KRD1 (-0.287) and PFR3 (-0.186), displayed weak or even negative loadings, signaling poor construct measurement. In contrast, the SCA construct in the initial model showed relatively better psychometric performance with a Cronbach's alpha of 0.740 and acceptable AVE and CR values, although SCA3 (0.385) remained problematic.

Following refinement and purification, the final measurement model demonstrates significant improvements. Items with weak or negative loadings were removed, resulting in better internal consistency across all constructs. KRD now includes three strong indicators (KRD3, KRD5, KRD6), raising its Cronbach's alpha to 0.731 and achieving an AVE of 0.581. Likewise, PFR retained three indicators (PFR2, PFR4, PFR6), improving its alpha to 0.676 and AVE to 0.513. The SCA construct in the final model is particularly robust, with all items demonstrating strong loadings (ranging from 0.733 to 0.838), a Cronbach's alpha of 0.865, and an AVE of 0.639, surpassing all validity and reliability benchmarks. This progression from the initial to the final model indicates improved measurement accuracy and supports the model's suitability for hypothesis testing using PLS-SEM.

Table 4 : Final Model measurements

Construct	Items	Loading >0.5 0.45=>0.5	Cronbach's alpha >0.70 0.60=>0.70	Composite reliability >0.7 0.60=>0.70	(AVE) >0.50 0.45=>0.5
	KRD3	0.689			
	KRD5	0.815	0.731	0.731	0.581
	KRD6	0.552			
	PFR2	0.627			
	PFR4	0.561	0.676	0.676	0.513
	PFR6	0.729			
	SCA1	0.838			
	SCA2	0.823			
	SCA4	0.733	0.794	0.865	0.616
	SCA5	0.739			

KDR: Knowledge of respiratory diseases; PFR: Pulmonary function risks; SCA: Smoking cessation.

Table 4 presents the psychometric evaluation of the measurement model, focusing on three key constructs: KRD, PFR, and SCA. All constructs demonstrate acceptable reliability and convergent validity, supporting the overall measurement integrity of the study. For the KRD construct, three items, KRD3 (0.689), KRD5 (0.815), and KRD6 (0.552), exceeded the minimum factor loading threshold of 0.50, indicating strong item-construct correlations. The Cronbach's alpha value of 0.731, as shown in Table 4, confirms internal consistency, while the CR of 0.731 falls within the acceptable range of 0.60–0.70. The AVE of 0.581 exceeds the 0.50 threshold, indicating that more than 58% of the variance in the indicators is accounted for by the latent KRD construct. In the case of PFR, the retained items, PFR2 (0.627), PFR4 (0.561), and PFR6 (0.729), also meet the minimum loading requirement. Although the Cronbach's alpha (0.676) and CR (0.676) are marginally below the ideal 0.70 level, they are still considered acceptable for exploratory studies. Importantly, the AVE value of 0.513 confirms sufficient convergent validity, as it surpasses the 0.50 benchmark.

The SCA construct demonstrates the strongest psychometric properties. The item loadings, SCA1 (0.838), SCA2 (0.823), SCA4 (0.733), and SCA5 (0.739), are all well above the 0.70 guideline, indicating excellent indicator reliability. The Cronbach's alpha (0.794) and Composite Reliability (0.865) both exceed the recommended thresholds, suggesting strong internal consistency. Furthermore, the AVE of 0.616 indicates that the construct has high convergent validity, with over 61% of the variance in the indicators captured by the latent construct.

Table 5 : The heterotrait-monotrait ratio of correlations

	KRD	PFR	SCA
KRD			
PFR	0.774		
SCA	0.389	1.142	

KDR: Knowledge of respiratory diseases; PFR: Pulmonary function risks; SCA: Smoking cessation

Table 5 presents the Heterotrait-Monotrait Ratio of Correlations, which is a robust method for evaluating discriminant validity among latent constructs in structural equation modeling. The constructs assessed in this study include KRD, PFR, and SCA. According to the widely accepted threshold suggested by Henseler et al. (2015), HTMT values should ideally be below 0.85 to confirm discriminant validity between constructs. The HTMT value between KRD and PFR is 0.774, which falls within the acceptable range and indicates good discriminant validity. Similarly, the HTMT value between KRD and SCA is 0.389, also well below the threshold, confirming that these constructs are conceptually distinct in the respondents' perceptions. However, a concern arises with the HTMT value between PFR and SCA, which is reported as 1.142. This value significantly exceeds the conservative (0.85) and even the liberal (0.90) cutoffs, suggesting a lack of discriminant validity between these two constructs. Such an overlap might imply that the measurement items for PFR and SCA are not sufficiently distinct or that respondents perceive these constructs as highly related.

Table 6 presents the Fornell-Larcker criterion used to assess discriminant validity among the latent variables: KRD, PFR, and SCA. According to Fornell and Larcker (1981), discriminant validity is established when the square root of the AVE for each construct (displayed on the diagonal) is greater than its correlations with other constructs (off-diagonal elements).

Table 6 : Discriminant validity Fornell-Larcker criterion

	KRD	PFR	SCA
KRD	0.694		
PFR	0.362	0.643	
SCA	-0.007	0.429	0.785

KDR: Knowledge of respiratory diseases; PFR: Pulmonary function risks; SCA: Smoking cessation;

The square root of the AVE for KRD is 0.694, which is higher than its correlation with PFR (0.362) and SCA (−0.007), indicating good discriminant validity for KRD. Similarly, PFR has a square root AVE of 0.643, exceeding its correlation with KRD and SCA (0.429), which also supports its discriminant validity. For SCA, the square root of the AVE is 0.785, clearly greater than its correlations with both KRD and PFR. These results confirm that each construct shares more variance with its indicators than with other constructs, thereby satisfying the Fornell-Larcker criterion.

The reflective structural model illustrated in Figure 3 presents the direct relationships between KRD, PFR, and SCA without the inclusion of socio-demographic interventions. The path coefficient from KRD to SCA is −0.269, with a p-value of 0.000, indicating a statistically significant negative association. This suggests that individuals with higher awareness of respiratory illnesses may, somewhat counterintuitively, exhibit less favorable attitudes toward smoking cessation. Such a result could reflect a psychological phenomenon in which knowledge of chronic respiratory consequences induces a sense of fatalism or reduced self-efficacy, thus deterring cessation efforts.

In contrast, the relationship between PFR and SCA is both positive and significant, with a path coefficient of 0.726 and a p-value of 0.000. This strong positive relationship indicates that individuals who perceive higher risks to their pulmonary function are substantially more likely to hold positive attitudes toward quitting smoking. This finding highlights the motivational role that perceived health threats, particularly those directly linked to lung capacity and respiratory function, can play in prompting cessation behaviors. The model's R^2 value for SCA is 0.455, which means that 45.5% of the variance in smoking cessation attitudes is explained by the combined influence of KRD and PFR. This level of explained variance reflects a moderately strong model, underscoring the importance of health risk perception, especially regarding pulmonary function, in shaping individual motivation to quit smoking. Overall, the model provides compelling evidence that while general knowledge of respiratory diseases alone may not be sufficient, or may even be counterproductive, emphasizing personalized pulmonary health risks is likely to be more effective in promoting smoking cessation.

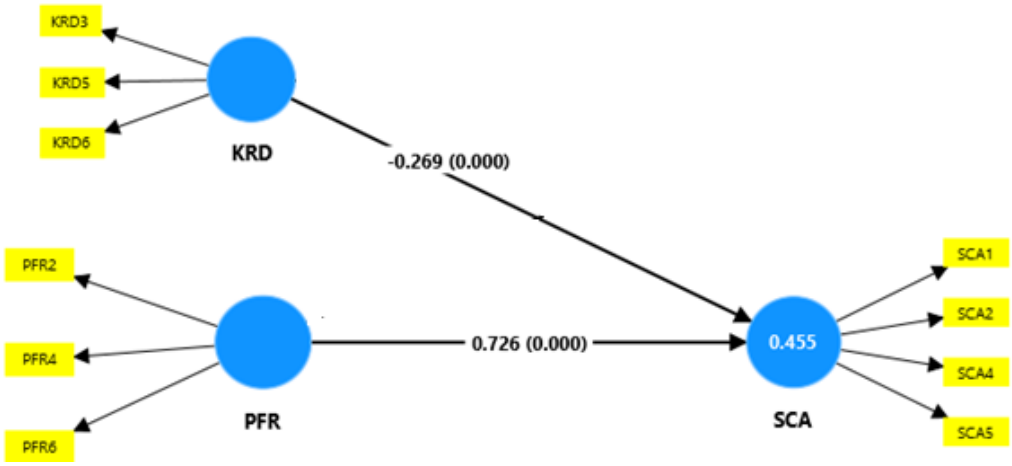

Figure 3 : Reflective structural (inner) model without intervention PLS-SEM

Table 7 : Direct model path analysis

Direct Path	Beta	SD	T statistics	P values
KRD -> SCA	-0.269	0.049	5.529	0.000
PFR -> SCA	0.726	0.058	12.57	0.000

KDR: Knowledge of respiratory diseases; PFR: Pulmonary function risks; SCA: Smoking cessation.

The results presented in Table 7: Direct Model Path Analysis reinforce the findings from the structural model in Figure 3 by statistically validating the direct effects of KRD and PFR on SCA. The path coefficient for KRD → SCA is −0.269, with a standard deviation (SD) of 0.049, a t-statistic of 5.529, and a p-value of 0.000. These values confirm that the relationship is statistically significant at the 0.01 level. The negative beta value indicates an inverse relationship, suggesting that increased knowledge about respiratory diseases correlates with lower motivation or intention to cease smoking. This could reflect a psychological barrier, where heightened awareness of long-term damage induces resignation or denial, making smokers feel that it may be "too late" to change outcomes.

Conversely, the PFR → SCA path yields a positive beta coefficient of 0.726, an SD of 0.058, a very strong t-statistic of 12.57, and a p-value of 0.000, indicating a highly significant and robust positive effect. This implies that individuals who perceive greater personal risk to their lung function are significantly more inclined toward smoking cessation. The strength of this coefficient suggests that perceived immediate health consequences, such as impaired breathing or reduced stamina, can act as a powerful motivator for quitting smoking. Together, these findings highlight a nuanced dynamic: while general disease knowledge might not effectively inspire cessation, perceived vulnerability to pulmonary decline is a much more effective lever for behavioral change. This insight has important implications for tailoring public health messages and designing smoking cessation programs that emphasize personal respiratory consequences over general disease education.

Table 8 : Coefficient of Determination (R^2)

	R-square	R-square adjusted
SCA	0.459	0.455

Table 8: R Square (R^2) provides an indication of the predictive strength of the structural model, specifically focusing on the dependent variable SCA. The R-square value for SCA is 0.459, and the adjusted R-square is 0.455. This means that approximately 45.9% of the variance in smoking cessation attitudes can be explained by the two predictor variables: KRD and PFR. The adjusted R^2, which corrects for the number of predictors and sample size, confirms that the model's explanatory power remains strong and is not inflated due to model complexity. These values suggest a moderate to substantial level of predictive accuracy. In behavioral and social sciences research, R^2 values in the range of 0.3 to 0.5 are considered meaningful, especially when examining human health behaviors like smoking cessation. Therefore, this model demonstrates that KRD and PFR together provide a reliable foundation for understanding and predicting individuals' likelihood or readiness to quit smoking.

Figure 4: Reflective Structural (Inner) Model with Intervention (PLS-SEM) presents the final extended model that incorporates socio-demographic variables, age, gender, education level, and income, as

moderators influencing the relationship between KRD, perceived PFR, and SCA. This model builds upon the earlier direct effects model by examining how these background characteristics alter or strengthen the direct relationships observed in smoking behavior change. The path analysis in this model indicates that PFR continue to exert a strong and statistically significant positive effect on smoking cessation attitudes, with a standardized path coefficient of β = 0.567 (p = 0.000). This suggests that individuals who perceive higher risks to their lung function are more likely to develop positive attitudes toward quitting smoking. In contrast, the path from KRD to smoking cessation attitudes is statistically significant but negative, with a coefficient of β = -0.317 (p = 0.004). This finding suggests a counterintuitive effect, where increased knowledge may not necessarily promote cessation intent, potentially due to psychological denial, fear, or feelings of helplessness among individuals already experiencing respiratory symptoms.

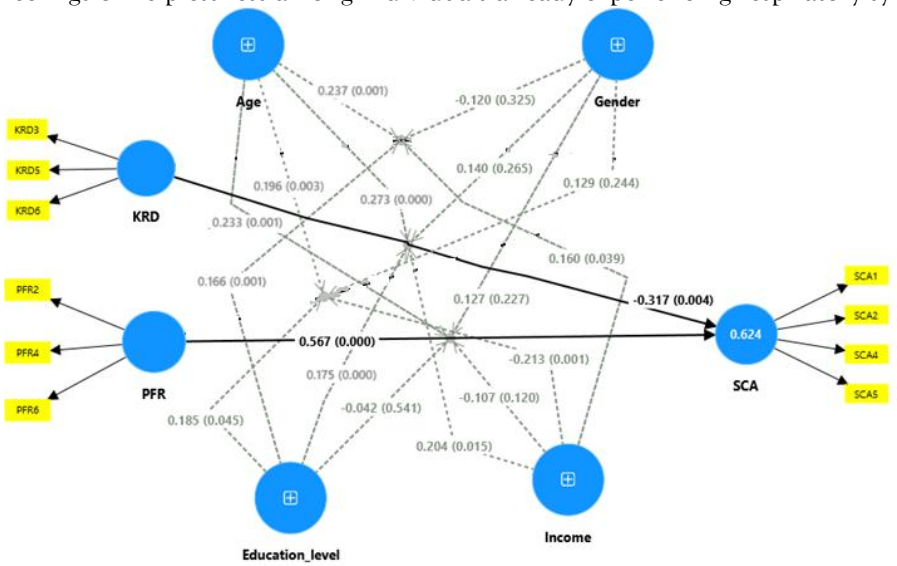

Figure 4 : Reflective structural (inner) model with intervention PLS-SEM

The inclusion of socio-demographic moderators enhances the explanatory power of the model significantly. The R-squared (R^2) value for SCA increases to 0.624, indicating that approximately 62.4% of the variance in smoking cessation attitudes is explained by the combined effects of KRD, PFR, and the moderating socio-demographic variables. This represents a considerable improvement from the previous model without intervention, which had an R^2 of 0.455. Further, significant moderating relationships are observed between socio-demographic factors and the core constructs. Age is positively associated with both KRD (β = 0.237, p = 0.001) and PFR (β = 0.166, p = 0.001), indicating that older individuals tend to be more knowledgeable and more aware of pulmonary risks. Education level also positively influences PFR (β = 0.175, p = 0.000), suggesting that higher education corresponds with greater awareness of lung function risks. Income, however, shows a mixed influence; it positively affects SCA through its effect on PFR but also demonstrates a negative moderating effect (β = -0.213), which may reflect disparities in access to healthcare or cessation resources.

Table 9 : with intervention Analysis

9	Beta	SD	T statistics >1.96	P values <0.05
Education_level x KRD -> SCA	0.175	0.071	1.056	0.000
Income x KRD -> SCA	0.204	0.084	2.441	0.015
Education_level x PFR -> SCA	-0.042	0.069	0.612	0.541
Age x PFR -> SCA	0.233	0.107	1.250	0.001
Age x KRD -> SCA	0.273	0.106	1.629	0.000
Gender x KRD -> SCA	0.140	0.125	1.116	0.265
Gender x PFR -> SCA	0.127	0.105	1.209	0.227
Income x PFR -> SCA	-0.107	0.069	1.555	0.120

KDR: Knowledge of respiratory diseases; PFR: Pulmonary function risks; SCA: Smoking cessation.

Table 9 presents the moderating effects of socio-demographic variables on the relationships between the independent variables, KRD and PFR, and the dependent variable, SCA. This interaction analysis was

conducted using a Partial Least Squares Structural Equation Modeling (PLS-SEM) framework with moderating terms. The results indicate several statistically significant moderating relationships. Notably, education level significantly moderates the relationship between KRD and SCA with a beta coefficient of 0.175 ($p = 0.000$), suggesting that individuals with higher education levels experience a stronger positive effect of knowledge on cessation attitudes. Similarly, income also shows a significant moderation effect on the KRD → SCA pathway ($\beta = 0.204$, $p = 0.015$), implying that higher income levels amplify the impact of knowledge on cessation motivation, potentially due to greater access to cessation resources and health literacy.

Age emerges as a strong and significant moderator in both key relationships: it positively moderates the PFR → SCA path ($\beta = 0.233$, $p = 0.001$) and the KRD → SCA path ($\beta = 0.273$, $p = 0.000$). These results suggest that older individuals are more responsive to both health knowledge and perceived risks in forming positive smoking cessation attitudes. This aligns with the likelihood that health concerns become more immediate or visible with age. However, other interaction terms were not statistically significant. For example, gender does not significantly moderate the effects of either KRD ($\beta = 0.140$, $p = 0.265$) or PFR ($\beta = 0.127$, $p = 0.227$) on smoking cessation. These results suggest that while there may be gender differences in smoking behavior, gender does not significantly shape how health knowledge or risk perception influences cessation attitudes in this sample. Similarly, education level's moderation on the PFR → SCA pathway is not significant ($\beta = -0.042$, $p = 0.541$), and income's interaction with PFR also lacks significance ($\beta = -0.107$, $p = 0.120$), indicating that these variables may not consistently shape the impact of perceived pulmonary risk on cessation attitudes.

5. DISCUSSION

The discussion of this study's findings illuminates the multifaceted relationships between cognitive understanding, risk perception, socio-demographics, and smoking cessation attitudes in Klang Valley. First, the strong and statistically significant positive association between perceived PFR and smoking cessation attitudes ($\beta = 0.726$, $p < 0.001$) confirms that pointing to tangible, health-related dangers, specifically impaired lung function, can effectively motivate smokers toward cessation. This aligns with the Health Belief Model, which posits that perceived susceptibility and severity of a health outcome inspire behavior change (Rosenstock et al., 1988). Similar evidence from studies like Al Khathlan et al. (2021) demonstrates that highlighting pulmonary threats increases attempts at quitting, reinforcing the importance of emphasizing real, bodily harms in public health messaging. Second, the unexpected negative coefficient for KRD, $\beta = -0.269$, $p < 0.001$, reveals that knowledge without empowerment may undermine cessation intent. While education can increase disease awareness, it can also foster hopelessness if individuals perceive the damage as irreversible. Alsiwat and Alayadi (2022) showed that dental providers' knowledge alone did not translate to action without self-efficacy and support. Thus, educational interventions must be coupled with motivational and skill-building components, like goal-setting, problem-solving techniques, and structured cessation programs, to avoid reinforcing fatalist attitudes (Adut, 2023).

Third, socio-demographic moderators, specifically age, income, and educational level, play a significant role in how cognitive factors translate into cessation attitudes. Our interventions revealed that older age, higher education, and greater income amplify the effects of both KRD and PFR on cessation intentions. This underscores the importance of cognitive resources, health literacy, and material means in converting awareness into action. Cutler and Lleras-Muney (2019) highlighted that these factors affect individuals' ability to absorb health information and pursue behavior change. Conversely, the lack of a gender effect is consistent with findings by Smith et al. (2020), suggesting that the cognitive-emotional drivers of cessation may similarly influence both men and women within this context.

This nuanced understanding has key implications for public health strategies. First, efforts should place a premium on communicating immediate, measurable health risks, such as lung function decline, using data, imagery, and testimonials. Second, information dissemination must be closely integrated with support systems that build self-efficacy. This includes resources such as quitlines, mobile health interventions, personalized counseling, and digital reminders, which have been shown to increase confidence and cessation success (Adut, 2023; Cobos-Campos et al., 2023). Third, interventions should be tailored socio-demographically: educational campaigns with data-driven messaging may resonate more with higher-educated audiences, while practical, accessible cessation tools could better serve lower-income or less-educated communities. Finally, while knowledge of disease can paradoxically foster a sense of futility, pairing it with achievable strategies may transform resignation into determination. Integrating

both theoretical awareness and practical empowerment ensures that educational efforts do not fall flat. In sum, this study illustrates that impactful smoking cessation programs require a holistic strategy, combining meaningful risk communication, self-efficacy support, and demographic sensitivity, to effectively catalyze behavior change and improve public health outcomes.

6. CONCLUSION

This study investigated the influence of KRD and perceived PFR on smoking cessation attitudes among adults in Klang Valley, Malaysia, with a focus on the moderating effects of socio-demographic factors. The findings revealed a complex but insightful dynamic: while perceived pulmonary function risk strongly and positively predicted cessation attitudes, knowledge of respiratory diseases unexpectedly exhibited a negative relationship. This suggests that mere awareness of health risks does not necessarily empower individuals to quit smoking, especially if such knowledge triggers feelings of helplessness or fatalism rather than proactive motivation. Moreover, socio-demographic variables such as age, income, and education were found to significantly moderate the effects of both KRD and PFR. These factors enhanced the predictive strength of health knowledge and perceived risks, emphasizing the role of cognitive maturity, access to health resources, and educational exposure in shaping health behavior change. Gender, however, did not significantly influence these pathways, indicating the generalizability of the psychological and cognitive mechanisms across male and female participants in this context.

The study contributes to public health literature by demonstrating that effective smoking cessation interventions must extend beyond conventional knowledge dissemination. Health communication strategies should incorporate vivid, personalized depictions of risk, particularly regarding lung function, and should be reinforced with tools that enhance self-efficacy and behavioral support. Equally important is the need to tailor these interventions to the socio-demographic characteristics of target populations to ensure both reach and relevance. In essence, this research underscores that smoking cessation is not solely a function of what individuals know, but also how they interpret and act upon that knowledge within their social and personal contexts. Integrating cognitive, emotional, and structural elements will be essential for designing impactful and equitable public health interventions that truly support individuals on their path to quitting smoking.

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