Development and Validation of a Smoking Behavior Instrument Using the Content Validity Index (CVI) Within the Theory of Planned Behaviour (TPB) Framework

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Abstract: High-quality, real-scale studies require validated instruments to ensure reliability and relevance. Content validity is a critical prerequisite in instrument development, reflecting the degree to which the items accurately represent the intended concepts. This study aimed to develop a smoking behavior instrument grounded in the Theory of Planned Behavior (TPB) and evaluate its content validity through expert assessment. The study was conducted in two stages. The first stage involved designing the instrument through a comprehensive literature review on smoking behavior and constructing items aligned with the TPB framework. The second stage assessed the instrument's content validity using the Content Validity Index (CVI) methodology, with input from four expert panelists. 40 items were developed: 12 for the attitude variable, 11 for subjective norms, 11 for behavioral control, and 6 for intention. The CVI scores ranged from 0.75 to 1.0 across all items, indicating high content validity. The smoking behavior instrument based on the TPB indicating high content validity for future stidies. This validated instrument provides a reliable tool for studying smoking behavior within the TPB framework. Further psychometric testing, including construct validity and reliability analysis, is recommended for broader applicability. Furthermore, this instrument has very high potential to be applied in public health, especially in efforts to stop smoking.

Keywords: content validity index, smoking, theory of planned behavior

Introduction

In most research, identifying the subject of study requires the use of instruments that are both valid and reliable, which significantly enhances the quality of the study [1], [2]. In quantitative research, validity serves as a primary measure of quality, indicating the extent to which concepts are accurately measured [1]. Validity is also defined as the ability of an instrument to measure the characteristics of the constructs under investigation, making it a critical factor in the application of measurement tools [3].

Content validity is a key category within construct and criterion validity, assessing whether an instrument sufficiently covers all relevant content or domains associated with a variable. In other words, it evaluates the extent to which research instruments comprehensively measure all facets of a construct [1]. As such, content validity is a prerequisite for other forms of validity, necessitating that content considerations are prioritized during instrument development. Establishing evidence of validity is essential for any study employing a measurement instrument [4], [5].

Content validity, often referred to as a form of face validity, evaluates the ability of a question or statement within an instrument to represent the intended construct. This type of validity also determines the extent to which items in an instrument reflect the full scope of the content domain. It ensures that selected items are representative of the overall content and accurately measure the concept being studied [6], [7]. To assess content validity, expert judgments are often utilized through the Content Validity Index (CVI). Experts evaluate each item in the instrument to determine its relevance and accuracy in measuring the intended construct [8], [9].

Globally, WHO data in 2020 showed that 22.3% of the world's population uses tobacco and has killed more than 8 million people each year, including around 1.3 million non-smokers who are exposed to secondhand smoke. Around 80% of the world's 1.3 billion tobacco users live in low and middle income countries. (WHO, 2023, Tobacco, https://www.who.int/news-room/fact-sheets/detail/tobacco)

Smoking is widely recognized as a major contributor to health complications and diseases. Numerous studies have

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demonstrated that smoking damages organs, leading to health issues such as hypertension, premature skin aging, visual impairments, and even blindness [10]. Lung cancer is the most prominent disease caused by smoking, as tar compounds are released during the combustion of tobacco [10], [12]. Other symptoms, including chronic coughing and shortness of breath, result from nicotine poisoning, while exposure to carbon monoxide—a highly toxic compound—significantly increases the risk of heart disease, often presenting as chest pain [13], [14].

The Theory of Planned Behavior (TPB) is a widely applied model in health promotion and nursing, offering a framework for understanding and influencing human behavior. It provides a structured approach to predicting specific, deliberate behaviors by considering three key precursors to behavioral intention: attitude, subjective norm, and perceived behavioral control [15], [16].

The TPB model theory is a very strong and predictive model in explaining human behavior including smoking behavior. There have been many TPB application studies related to smoking cessation behavior and risk prevention [17], [18], [19], as well as a study on the intention to initiate smoking a specific TPB in adolescent boys has been conducted [20]. One of these studies that Cigarette smoking and intention to smoke cigarettes were predicted by attitude and perceived behavioral control, so that The theory of planned behavior provided solid explanations of intention to use cigarettes among waterpipe smokers **(17)**.In these studies, the instruments used were generally made by researchers with a different number of statement items for each TPB variable based on the literature studies and modified TPB statement-making guidelines by Francis, et al., and went through expert trials and Cronbach's Alpha, which then tried on several respondents according to the criteria. However, there is a lack of standardized instruments that measure smoking behavior.

Given the significant health risks associated with smoking, strategies for behavior change using the TPB model are crucial for prevention. Despite the effectiveness of TPB in addressing smoking behavior, a validated, standardized measurement scale remains lacking. This study aims to develop and validate a TPB-based smoking behavior instrument using the Content Validity Index (CVI) methodology to ensure content relevance and applicability.

Materials and Methods

1. Instrument Design

In the first phase, Instrument Design, two main steps were carried out: a literature review and the development of a Theory of Planned Behavior (TPB)-based instrument.

a. The first step was a literature review, which involved a comprehensive study of literature related to smoking behavior and its health consequences. This step aimed to provide the theoretical foundation for designing the instrument and ensure that the developed items accurately reflected the measured constructs.

b. The second step was instrument development based on the TPB framework. The TPB model serves as a theoretical foundation for understanding and predicting human behavior, where intention influences behavior, which is determined by three key factors: attitude, subjective norms, and perceived behavioral control. The developed instrument

consisted of 40 statement items distributed across four main variables: intention, attitude, subjective norms, and behavioral control. The formulation of statement items or sentences from the instrument on the four main variables of the TPB is determined based on a literature review on smoking, which is then formulated or created following the guidelines for compiling TPB-based instruments that have been developed previously **(21)**. Several critical aspects were considered in the development process, including 1) The target population of the study; 2) The specific behavior under investigation; 3) Measuring intention using generalized intention statements; 4) Common perceived advantages and disadvantages of the behavior; 5) The role of significant others (e.g., family and friends) in supporting or discouraging the behavior; and 6) Perceived barriers or facilitators that might affect behavior adoption. This systematic approach ensured that the instrument adequately covered all relevant constructs within the TPB model.

2. Expert Judgments

The second phase, Expert Judgments, was conducted to validate the instrument through expert evaluation. Content validity was assessed using the Content Validity Index (CVI), a rigorous method for evaluating the relevance and adequacy of instrument items. Each item was rated on a 4-point ordinal scale (1 = Irrelevant, 2 = Somewhat relevant, 3 = Quite relevant, and 4 = Very relevant). Items were considered valid if at least 80% of experts rated them as 'Quite relevant' or 'very relevant' (CVI ≥ 0.80). A minimum acceptable CVI threshold was set at 0.70 [24].

The instrument was evaluated by four expert panelists specializing in behavioral science and health promotion experts with more than 5 years of experience and including lecturers or experts in academic fields. The expert panel was assembled following a formal request to the head of the Southeast Sulawesi branch of the PPPKM (Association of Public Health Educators and Promoters), who recommended that experts meet the required criteria. Before the instrument was provided for assessment, each expert was asked for their consent and willingness to participate in the validation process. According to standard content validation procedures, a minimum of three experts from relevant scientific fields is required to ensure the appropriateness and accuracy of the instrument's content. The feedback provided by the expert panel informed the final adjustments to the instrument, ensuring its validity and readiness for future research use.

Results and Discussion

Instrument design

The developed instrument comprises 40 statement items designed to measure individuals' behavior toward cigarette consumption based on the Theory of Planned Behavior (TPB) framework (Table 1). Of these 40 items, 34 represent the predictor variables of intention, distributed as follows: 12 items for attitude, 11 items for subjective norms, and 11 items for perceived behavioral control. The remaining 6 items specifically measure the intention variable. The predictor variables can be assessed using both direct and indirect measurement approaches, ensuring a comprehensive evaluation of the constructs.

Table 1. The results of developing TPB-based smoking behavior statements items

No	Statements	Responses									
1.		very useless	1	2	3	4	5	6	7	very useful
2.	In my opinion, from now on starting to stop smoking is something that	very pleasant	1	2	3	4	5	6	7	very unpleasant
3.		very false to do	1	2	3	4	5	6	7	very true to do
4.		very good	1	2	3	4	5	6	7	very bad

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No	Statements	Responses								
5.	If from now on I stop smoking, I will feel that I am doing something positive for myself	very impossible	1	2	3	4	5	6	7	very possible
6.	If I immediately check my health condition when I suddenly feel pain in the chest, I can prevent it from getting to a worse condition	very impossible	1	2	3	4	5	6	7	very possible
7.	if I do a cardiac record check while feeling pain in the chest, I can detect the problem at the early stage	very impossible	1	2	3	4	5	6	7	very possible
8.	if there is a history of chest pain, hypertension, coughing and tightness, I should often consult to a health worker	very impossible	1	2	3	4	5	6	7	very possible
9.	Check the condition of the heart and lungs more often for abnormalities by health officials is ………	very undesirable	-3	-2	-1	0	1	2	3	very desirable
10.	I feel concerned when my cough is accompanied by pain in my left chest	very undesirable	-3	-2	-1	0	1	2	3	very desirable
11.	Checking my heart, lungs and eyes by a medical specialist for myself is ………	very undesirable	-3	-2	-1	0	1	2	3	verydesirable
12.	Detecting problems such as visual disturbances, chest pain, impotence, premature wrinkles on my skin at this point is …………	very undesirable	-3	-2	-1	0	1	2	3	very desirable
13.	My family and friends think that I must start to quit smoking now	totally disagree	1	2	3	4	5	6	7	totally agree
14.	My family and friends always think controlling my blood pressures, checking my lungs and heart for abnormalities by a medical specialist	totally disagree	1	2	3	4	5	6	7	totally agree
15.	Family and friends expect me to perform routine self-checks for infections of my teeth, wrinkles on my skin	totally disagree	1	2	3	4	5	6	7	totally agree
16.	Other smokers expect me ..... do lung and heart checkups while I have chest pain	really shouldn't be	-3	-2	-1	0	1	2	3	really should be
17.	Other smokers would .... if they always control blood pressure as early as possible	totally disagree	-3	-2	-1	0	1	2	3	totally agree
18.	other smokers told that I .... my eyes, lungs and heart checkups by a medical specialist	really shouldn't do	-3	-2	-1	0	1	2	3	really should do
19.	people around me .... to quit smoking if I have a cough with chest pain	totally disagree	-3	-2	-1	0	1	2	3	totally agree
20.	Doing regular health checks on the lungs and heart for any abnormalities by other smokers is .... for me	very unimportant	1	2	3	4	5	6	7	very important
21.	Doing a heart check for sudden chest pain which the cardiologists think I should do is .... for me	very unimportant	1	2	3	4	5	6	7	very important
22.	The consent of the people around me to health checks such as blood pressure, vision, impotence regularly .... for me	very unimportant	1	2	3	4	5	6	7	veryimportant
23.	The opinion of other smokers who agree that checking the lungs and heart for abnormalities by a specialist health worker .... for me	very unimportant	1	2	3	4	5	6	7	very important
24.	I am sure that I can find signs of abnormalities in my heart if I want	totally disagree	1	2	3	4	5	6	7	totally agree
25.	Routine checkup for abnormalities in my lungs and heart, depending on my own will	totally disagree	1	2	3	4	5	6	7	totally agree
26.	For me to confirm the problem with my own heart due to the pain in the chest and the tightness	easier	1	2	3	4	5	6	7	more difficult
27.	Cigarettes that are continuously consumed can cause lung cancer	very impossible	1	2	3	4	5	6	7	very possible
28.	When i did check on the lungs i felt rushed	very impossible	1	2	3	4	5	6	7	very possible
29.	The chest pain I feel right now is not the result of smoking	very impossible	1	2	3	4	5	6	7	very possible
30.	When I do a heart check for any abnormalities I feel rushed	very impossible	1	2	3	4	5	6	7	very possible
31.	If I constantly consume cigarettes, I ...... to suffer from lung cancer	unlikely	-3	-2	-1	0	1	2	3	most likely
32.	If I am in a hurry when doing my lungs checkup, then ...... to detect any symptoms of lung cancer	more difficult	-3	-2	-1	0	1	2	3	easier
33.	If I smoke suddenly I get pain in my left chest accompanied by tightness, then ...... there is already a problem with my heart	unlikely	-3	-2	-1	0	1	2	3	most likely
34.	If I am in a hurry when doing my heart checkup, then .... to detect symptoms of abnormalities in the heart	more difficult	-3	-2	-1	0	1	2	3	easier
35.	I hope to stop smoking	totally disagree	1	2	3	4	5	6	7	totally agree

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No	Statements	Responses									
36.	At this point I intend to give up smoking	totally disagree	1	2	3	4	5	6	7	totally agree
37.	I really want to quit smoking	totally disagree	1	2	3	4	5	6	7	totally agree
38.	I hope to always refuse when a friend offers to smoke a cigarette	totally disagree	1	2	3	4	5	6	7	totally agree
39.	At this point I intend to refuse if a friend offers to smoke	totally disagree	1	2	3	4	5	6	7	totally agree
40.	I would love to turn down a friend's offer to smoke	totally disagree	1	2	3	4	5	6	7	totally agree

Note: attitude variables items 1 to 12 (direct attitude items 1 to 4 and indirect attitude items 5 to15), subjective norms variables items 13-23 (direct subjective norms items 13 to15 and indirect subjective norms items 16 to 23), behavior control variables items 24-34 (direct behavior control items 24 to 26 and indirect behavior control items 27 to 34) and intention variables items 35 to 40.

CVI (Content Validity Index) Study

The Content Validity Index (CVI) results from the validity assessment of statements regarding TPB-based smoking behavior, evaluated by four expert panels, yielded scores ranging from 0.75 to 1.0 (Table 2). From the results, there are several items that have a low CVI score (0.75) which is above the minimum threshold, but the researcher stated that the item is valid and accepted without any modification because only 1 expert gave a score of 2 (somewhat relevant) but the other 3 experts on average gave a score of 3 or 4 (quite relevant and very relevant) and previous studies that the CVI item threshold of 0.70 is still considered acceptable for content validity. The CVI score for each statement was calculated by dividing the total score by the number of experts. Each item was assigned a score of 1 if the expert rated it as "quite relevant" (3) or "very relevant" (4) and a score of 0 if rated as "irrelevant" (1) or "somewhat relevant" (2). The mean item-level CVI (I-CVI) across all statement items was 0.91. This average I-CVI was calculated by summing the scores assigned to each item by the four experts (where applicable) and dividing the total by the number of experts. Subsequently, the results for all items were aggregated to determine the overall average score. A detailed summary of the CVI results for all statement items, as assessed by the four experts, is presented in Table 2.

Table 2 The results of the CVI validity test on TPB-based smoking behavior statements items

Variable	Item Statement	Expert 1				Expert 2				Expert 3				Expert 4				Score CVI	Information
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
Direct Attitude	1				√			√					√			√		1.0	Valid
	2			√				√				√				√		1.0	Valid
	3			√				√				√					√	1.0	Valid
	4				√			√				√					√	1.0	Valid
Indirect Attitude	5			√					√				√				√	1.0	Valid
	6			√				√				√					√	1.0	Valid
	7		√					√					√				√	0.75	Valid
	8		√					√					√				√	0.75	Valid
	9			√				√				√				√		1.0	Valid
	10			√				√					√			√		1.0	Valid
	11			√			√						√			√		0.75	Valid
	12			√				√					√			√		1.0	Valid
Direct Subjective	13			√					√				√			√		1.0	Valid
	14			√			√					√				√		0.75	Valid
	15			√				√				√					√	1.0	Valid
Indirect Subjective Norms	16			√				√				√				√		1.0	Valid
	17			√				√				√				√		1.0	Valid
	18			√			√						√			√		0.75	Valid
	19				√				√				√			√		1.0	Valid
	20			√			√					√				√		1.0	Valid
	21			√			√					√				√		0.75	Valid
	22			√			√						√		√			0.75	Valid
	23			√			√					√					√	0.75	Valid
Direct Behavior Control	24			√			√						√			√		0.75	Valid
	25			√			√						√				√	0.75	Valid
	26			√			√					√				√		1.0	Valid
Indirect Behavior Control	27			√					√			√					√	1.0	Valid
	28			√			√						√			√		0.75	Valid
	29		√						√				√				√	0.75	Valid
	30			√			√					√				√		0.75	Valid
	31			√					√			√				√		1.0	Valid
	32			√			√					√				√		0.75	Valid
	33			√			√					√				√		1.0	Valid
	34				√		√						√			√		0.75	Valid
Intention	35			√					√				√			√		1.0	Valid
	36			√			√						√			√		1.0	Valid
	37			√			√						√				√	1.0	Valid
	38			√					√				√				√	1.0	Valid
	39			√			√						√			√		1.0	Valid
	40			√			√						√				√	1.0	Valid

Mean I-CVI=0.91, S-CVI/VA=0,62, S-CVI/Ave=0.91

Discussion

The development of a new instrument for assessing smoking cessation behavior based on the Theory of Planned Behavior (TPB) represents a novel contribution of this study. To ensure the validity of the instrument's content, engaging an expert panel was identified as a critical step in the development process. The construction of the instrument was guided by established methodologies for creating TPB-based tools and a comprehensive literature review on the health impacts of smoking. The inclusion of evidence from literature reviews in the statement items was aimed at minimizing the detrimental health effects of smoking, particularly the risk of smoking-related disease complications.

The resulting instrument comprises 40 items designed to measure the intention variable and its predictors. The predictors of intention include three key variables: attitudes, subjective norms, and perceived behavioral control. Attitudes reflect an individual's overall evaluation of a behavior, including beliefs about its consequences and the desirability of its outcomes. Subjective norms capture the perceived social pressure from influential figures, such as parents or peers, to perform or refrain from specific behaviors. Perceived behavioral control addresses the ease or difficulty an individual perceives in executing a behavior. The intention variable, as a precursor to behavior, represents an individual's readiness to act and is considered a central motivational factor influencing behavior, as highlighted in prior studies [21-29].

Following the instrument development, the statement items underwent an evaluation using the Content Validity Index (CVI) to determine their validity. The CVI is a widely used quantitative method for assessing the content validity of instrument items [29], [30]. The CVI has two primary components: the Item Content Validity Index (I-CVI), which assesses the validity of individual items, and the Scale Content Validity Index (S-CVI), which evaluates the overall scale. The S-CVI can be calculated using two methods: S-CVI/UA (universal agreement), which represents the proportion of items rated as valid (scores of 3 or 4) by all experts, and S-CVI/Ave (averaging), which provides the mean I-CVI score across all items [7], [30], [31], [32].

The S-CVI emphasizes the quality of the items rather than the consensus among experts. For each item, the I-CVI is calculated as the ratio of experts assigning a score of 3 or 4 to the total number of experts [31], [32]. In this study, the CVI evaluation by four expert panelists demonstrated that all instrument items achieved valid ratings. Compared to previous TPB-based smoking behavior instruments, our CVI scores (ranging from 0.75 to 1.0, with a mean I-CVI of 0.91) indicate high content validity. These value align with established benchmarks for content validity assessment in health bahavior research. Fifteen statement items, primarily within the predictor variables (attitudes, subjective norms, and perceived behavioral control), had an I-CVI of 0.75, while the remaining items achieved an I-CVI of 1.0. A threshold I-CVI score of 0.70 is generally considered acceptable for content validity [24].

Comparatively, similar recent studies have reported I-CVI values ranging from 0.5 to 1.0, indicating moderate to high content validity, and S-CVI/UA and S-CVI/Ave values of 0.63 and 0.91, respectively, reflecting overall moderate to high scale validity [30]. In cases where an I-CVI value was <1.0, discrepancies typically arose because one expert assigned a score of 2, indicating lower relevance, while the remaining experts rated the items highly. Nevertheless, all items were ultimately deemed valid and acceptable due to the majority consensus. In conclusion, the developed instrument demonstrated satisfactory content validity, as evidenced by the high I-CVI and S-CVI scores. This indicates that the statement items are sufficiently robust for further testing and application in studies on smoking cessation behavior. Future studies should focus on conducting construct validity analysis and reliability testing to further establish the robustness of this instrument. Additionally, cultural adaptations may be necessary for broader applicability in diverse populations.

Conclusion

This study successfully developed and validated a TPB-based smoking behavior instrument with strong content validity. Further validation, including reliability testing and construct validity analysis, is recommended to ensure broader applicability in smoking cessation research.

Ethics of Study

Research Institute, State University of Surabaya.

Conflict of Interest

The authors have no conflict of interest.

Authors' Contributions

Conception and design: Narmawan, Ida Djafar. Analysis and interpretation of the data: Narmawan. Drafting of the article: La Saudi. Critical revision of the article for important intellectual content: Narmawan. Final approval of the article: Vernando Yanry Lameky. Provision of study materials or patients: Wendi Muhammad Fadhli, Roland Lekatompessy. Statistical expertise: Ahmil. Obtaining of funding: Safaruddin. Administrative, technical, or logistic support: Satria Eureka Nurseskasatmata. Collection and assembly of data: Cicilia Ika Wulandari H

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