

Research Article

The Development and Validation of a Scale to Understand Smoking Cessation Efforts Among Middle-Aged Male Workers

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Abstract

The purpose of this study was to develop and test the reliability and validity of a scale assessing the efforts made by midlife adult male smokers to quit smoking. The draft of the scale, designated the Smoking Cessation Assessment of Progress Scale (SCAPS), was developed a qualitative inductive analysis of the characteristics of successful smoking cessation efforts among midlife adult male workers in a previous study by the authors. The subjects were men in their 30s and 40s who were employed, had quit smoking for at least six months, and who had succeeded in quitting without seeking outpatient smoking cessation treatment. After a preliminary survey, the main survey was conducted. Data was analyzed using the maximum likelihood Promax rotation method. Confirmatory factor analysis was subsequently conducted, resulting in the identification of three factors and 17 items. The factors identified were "response to smoking cravings," "perceived benefits associated with successful smoking cessation," and "positive perception of smoking cessation. Cronbach's alpha coefficients for each subscale ranged from 0.702 to 0.873, which were generally favorable. Construct validity was generally ensured by confirmatory factor analysis and the estimates extracted from the results for each factor. The reliability and validity of SCAPS were generally verified.

Keywords

Middle-Aged, Males, Worker, Quit Smoking Support, Scale, Smoking Cessation

1. Introduction

Smoking is a known risk factor for various malignant neoplasms [1-3], ischemic heart disease [4], cerebrovascular disease [5], chronic obstructive pulmonary disease (COPD) [6], and diabetes mellitus [7].

In Japan, smoking prevalence has been on a slight downward trend, with the male smoking rate decreasing from 39.4% in 2009 to 27.1% in 2019, a decrease of more than 10 percentage points over a 10-year period [8].

However, among the G7 group of industrialized economies, the male smoking rate in Japan is the second highest after that of France [9]. In particular, the smoking rates of Japanese men in their 30s and 40s are 33.2% and 36.5%, respectively, which are higher than those of other age groups [8]. Of these smokers, more than 20% of have expressed a desire to quit smoking.

The study's target population is comprised of men in

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mid-adulthood, defined as individuals in their 30s and 40s, in accordance with the definition proposed by Hattori [10]. Men in mid-adulthood are in their prime working years, often in managerial positions at work, and at home many are experiencing marriage, childbirth, and child rearing. Such men are often under a lot of stress because of their various roles in both public and private life. Consequently, men in mid-adulthood are more prone to stress-related health problems [11], and have an increased incidence of lifestyle-related diseases such as malignant neoplasms and cardiovascular diseases [12].

In Japan, a "smoking cessation support manual" [13] was developed in 2006 and has been used to support workers in quitting smoking. This manual was revised in 2013 as the "Smoking Cessation Support Manual (Second Edition)" [14], and occupational health professionals provide smoking cessation support to smokers in the workplace by referring to these materials and offering health guidance after medical examinations. Specifically, those who wish to quit smoking are introduced to an outpatient smoking cessation clinic that is as close to their workplace or home as possible and is easy to visit, and are recommended to attend a consultation.

While there are smokers who attend outpatient smoking cessation clinics, there are also smokers who do not attend outpatient smoking cessation clinics. For example, there are smokers who wish to quit smoking but do not wish to visit an outpatient smoking cessation clinic, and smokers who are interested in quitting smoking but are not ready to take up the challenge. Furthermore, there are those who have no interest in quitting smoking, accounting for the greatest proportion, approximately three-quarters [15].

Occupational health workers provide these various smokers with ongoing smoking cessation support, including providing information on smoking cessation at annual post-healthcare guidance sessions after medical examinations, throughout their tenure at their workplace.

As occupational health workers are involved with smokers in the workplace over potentially a long period of time, the status of a smoker's cessation efforts, such as their thoughts on smoking and smoking cessation, and their smoking status in the workplace, may change. For example, a smoker who has visited an outpatient smoking cessation clinic may self-interrupt and decide to try to quit smoking on their own, or they may even begin smoking again. Conversely, a person who has been interested in quitting smoking but has been unable to try may request a visit to an outpatient smoking cessation clinic.

In providing smoking cessation support to these various smokers, occupational health professionals need to accurately grasp the status of the smokers' efforts to quit smoking and provide support accordingly. In other words, if the status of smokers' efforts to quit smoking can be understood, occupational health workers will be better able to provide effective support.

The objective of this study was to examine the experiences of successful quitters in order to identify a framework that

could be used to better understand the efforts of current smokers to quit smoking. In a previous study, we identified the core characteristics of successful quitters' experiences in their efforts to quit smoking [16]. The objective was to identify the factors related to successful smoking cessation in order to assess the current status of efforts to quit smoking among adult mid-adulthood male smokers receiving smoking cessation support from occupational health professionals.

Several scales have been developed to assess smokers' progress towards successful cessation, including the Smoking Abstinence Questionnaire (SAQ) [17], a 55-item instrument that captures smokers' physiological and psychological expectations regarding successful smoking cessation. The scale was developed based on the hypothesis that the higher a smoker's expectations for quitting smoking, the more successful they will be in quitting. The Smoking Abstinence Expectancies Questionnaire (SAEQ) [18], which was subsequently developed, is a 28-item scale that assesses smokers' short-term physiological, psychological, and emotional expectations of quitting smoking. Recently, the Challenges to stopping smoking scale (CSS-21) has been developed as a comprehensive scale to assess various personal and environmental factors that influence smoking behavior in order to achieve successful smoking cessation [19].

However, although each of these scales fulfills the purpose for which it was developed, they were developed based on focus group interviews with smokers, literature reviews, and existing models, and were not developed based on the experiences of successful quitters. It could be argued that these scales are prospective, in that they identify the challenges current smokers face when trying to quit. It is our contention that the development of a retrospective scale, which identifies the strategies employed by smokers to overcome these challenges, would serve as an effective means of assessing their progress towards smoking cessation.

Therefore, the purpose of this study was to develop a scale to assess the status of smoking cessation efforts among mid-adulthood adult male smokers based on the previously identified characteristics of efforts that led to successful smoking cessation among mid-adulthood adult male workers, and to examine the reliability and validity of such a scale¹. This scale, designated the Smoking Cessation Assessment of Progress Scale (SCAPS), is intended to facilitate the provision of support to midlife adult male smokers according to their current smoking cessation efforts. It is anticipated that this scale will contribute to an increase in the successful cessation of smoking among mid-adulthood male smokers.

2. Subjects and Methods

The subjects of this study were men in their 30s and 40s

¹ This study is drawn from a doctoral dissertation submitted to the Graduate School of Nursing, Miyagi University, with additions and revisions. A part of this thesis was presented at the 8th Annual Meeting of the Japanese Society of Public Health Nursing.

who were employed, had quit smoking at least 6 months prior to recruitment, and had successfully quit smoking without undergoing outpatient smoking cessation treatment.

The study was conducted in two stages. In the first stage, a draft scale was developed, a preliminary survey was conducted, and the scale's reliability and validity were verified. In the second stage, the draft scale was revised, and the main survey was conducted to assess its reliability and validity.

2.1. Phase 1: Preliminary Survey

2.1.1. Scale Drafting Process

In a previous study by the authors, a qualitative inductive study using semi-structured interviews was conducted to identify the core characteristics of the experiences that led to successful smoking cessation among 14 mid-adulthood male workers¹⁶. Using the 117 subcategories obtained from this study, a draft scale for assessing the progress of smoking cessation efforts was developed. Content validity was assessed by a panel consisting of one expert in qualitative research, one expert in public health nursing, one expert in psychiatric nursing, two public health nurses (one of whom specialized in psychology), and one physician specializing in public health who had been involved in smoking cessation support for many years. This resulted in the addition of one item, some modifications to the wording, and the creation of a draft scale of 118 items. Using the draft, a pretest was conducted on three subjects to identify any issues.

2.1.2. Survey Period and Content

The survey was conducted from August 2017 to September 2017. Participating organizations were recruited by contacting decision-makers by mail or e-mail through the local network of occupational nurses, study groups related to occupational health, and liaison councils. Organizational-level consent was obtained by explaining the study orally and in writing to the previously identified decision-maker. The preliminary survey questionnaire was then distributed to those staff who met the conditions of inclusion into the study. The voluntary nature of participation was made clear to all potential participants and the return of a completed questionnaire was considered to represent their consent to participate in the study.

The content of the survey consisted of demographic items, the draft scale, the [19] for construct validation, and the Kano Test for Social Nicotine Dependence (KTSND) [20]. The demographic data collected included age, type of business, number of employees, job title, employment status, highest level of education, marital status, duration of smoking cessation, smoking cessation treatment, age at smoking cessation, average number of cigarettes smoked per day when smoking, duration of smoking, and number of previous attempts to quit smoking.

The CSS-21 [19] was developed as a scale to predict smoking cessation when smokers attempt to quit, and its

reliability and validity have been confirmed. It was expected to correlate positively with the proposed scale used in this study. As the CSS-21 had not previously been translated into Japanese, we proceeded to translate the scale with the permission of the original authors. In order to ensure an adequate translation of the scale, we employed the methodology proposed by Inada [21] in his "Basic Guidelines for Scale Translation." This entailed having two translators translate the English version into Japanese, and another two translators back-translate the Japanese version into English. The KTSND [20] is a scale used for judging psychological nicotine dependence. The higher the score, the stronger the psychological dependence. Since the subjects in this study were considered to be successful quitters who had overcome their nicotine dependence, a negative correlation with the proposed scale was expected.

2.1.3. Methods of Analysis

Responses to items in the proposed scale were rated on a 4-point Likert scale, ranging from "agree" (4 points) to "disagree" (1 point). However, in reversed-key items, scoring was reversed from "agree" (1 point) to "disagree" (4 points). IBM SPSS Statistics (ver. 23) software was used to conduct the analysis, with the significance level for all two-tailed tests set to $p < 0.05$.

2.1.4. Item Analysis

Frequency of missing values, confirmation of ceiling and floor effects, correlation analysis between items, Item-Total Correlation Analysis (I-T correlation analysis), and Good-Poor Analysis (G-P analysis) were conducted. The following five criteria were used for eliminating items. (1) Ceiling and floor effects: If the sum of the mean and standard deviation of the scores for an item was significantly higher than the maximum score, or significantly lower than the minimum score, the item was rejected as the distribution of scores was biased towards high or low scores, respectively. (2) Correlation between items: Items with $r = 0.7$ or above were considered to be strongly correlated, and therefore, one of the two items was removed. (3) I-T correlation analysis: The correlation between the score of each item and the total score of the whole scale was calculated, and items with a correlation of 0.2 or below were rejected as they were considered to make little contribution to the scale. (4) G-P analysis: The mean value of the total score of each item in the questionnaire was divided into two groups, a high-scoring group and a low-scoring group, and the difference between the means of the two groups was tested, and the items for which no significant difference was found were deleted.

2.1.5. Exploratory Factor Analysis

After removing any non-contributory items via item analysis, the number of factors estimated for Minimum Average Partial (MAP) and Squared Multiple Correlation (SMC) were

confirmed using the Hori [22] method for determining the number of factors. Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was found to be greater than 0.50, ensuring that the sample size was appropriate for conducting factor analysis [23]. Then, exploratory factor analysis with a promax rotation by maximum likelihood method was conducted. If the correlation between factors was low, an exploratory factor analysis of the varimax rotation using the main factor method was also conducted. Items with commonality less than 0.16 were removed. The minimum factor loadings were set at 0.35 or higher, considering the fact that this was a preliminary survey.

2.1.6. Examination of Reliability

Cronbach's alpha coefficients for the entire questionnaire and for each factor were obtained to confirm internal consistency reliability.

2.1.7. Examination of Validity

The construct validity of the proposed scale was examined by comparison with the CSS-21 [19] and the KTSND [20].

2.1.8. Results

Consent was obtained from 16 organizations, and questionnaires were distributed to a total of 300 subjects. 147 subjects responded (response rate: 49%). Of these, 1 reported still smoking when drinking, 7 reported visiting a smoking cessation clinic, 4 had quit smoking less than 6 months before the study, 5 were not in their 30s or 40s, and 1 response was returned with many missing values. After these 18 respondents were excluded, 129 participants (valid response rate: 87.8%) were included in the analysis.

Thirteen items were found to be relevant to the proposed scale based on the ceiling effect, and 21 items via the floor effect. 11 items were accepted via the correlation analysis, 32 items via the G-P analysis, and 22 items were identified through the I-T correlation analysis. A total of 59 items were excluded due to overlap. The remaining 59 items were as assigned to 7 factors for MAP and SMC by the factor numbering method. The KMO was 0.68, which was generally appropriate for the sample. Because the inter-factor correlations were low (less than 0.35), an exploratory factor analysis of varimax rotation using the main factor method was conducted. The final sample consisted of 47 items in a seven-factor structure. Factor I contained 14 items, Factor II contained 10 items, Factor III contained 4 items, Factor IV contained 5 items, Factor V contained 7 items, Factor VI contained 4 items, and Factor VII contained 3 items.

Pearson's correlation coefficient between the proposed scale and the KTSND [20] showed a negative correlation of -0.107, which was not statistically significant. However, a slightly significant negative correlation was found with Factor II -0.180 and Factor V -0.192. For the proposed scale and the CSS-21 [19], Pearson's correlation coefficient was 0.589 for

the total score of the internal factor, 0.474 for the total score of the external factor, and 0.407 for the total score of the two factors. All were statistically significant.

Cronbach's alpha coefficient for the entire scale was 0.892, and the alpha coefficients for each factor were 0.873 for factor I, 0.797 for factor II, 0.800 for factor III, 0.734 for factor IV, 0.672 for factor V, 0.668 for factor VI and 0.576 for factor VII.

2.2. Phase 2: Main Survey

2.2.1. Selection of Subjects

Using the national database of corporations available on the Internet, the number of establishments in each prefecture was calculated, and stratified random sampling was conducted, and a total of 500 establishments were selected. A letter was mailed to the decision-makers of the selected establishments, explaining the study and requesting their participation. After obtaining organizational consent, questionnaires were distributed to those who met the inclusion conditions of this study. As with Phase 1 of the study, the voluntary nature of participation was made clear to all potential participants and the return of a completed questionnaire was considered to represent their consent to participate in the study.

2.2.2. Survey Period and Content

The survey was conducted from September 2017 to June 2018. The survey included demographic items and the revised scale. The demographic data collected was the same as in the preliminary survey. The revised scale consisted of 47 items obtained from the preliminary survey, with the order of the items rearranged. Responses were on a 4-point positively and reverse keyed Likert scale.

2.2.3. Analysis Method

Statistics (ver. 25) software was used to verify the reliability and validity of the item analysis and exploratory factor analysis. IBM Statistics Amos (ver. 25) software was used for confirmatory factor analysis. The significance level for all two-tailed tests was set to $p < 0.05$.

2.2.4. Item Analysis

Frequency of missing values, correlation analysis among items, confirmation of ceiling and floor effects, I-T correlation analysis, and G-P analysis were conducted to determine items for removal. The deletion criteria were the same as in the preliminary survey except that, for the I-T correlation analysis, confirmatory factor analysis was also considered, and the correlation between the score of each item and the total score of the whole was examined.

2.2.5. Exploratory Factor Analysis

After eliminating items based on the results of the item

analysis, the number of factors was estimated by the factor number determination method. In order to conduct a confirmatory factor analysis, an exploratory factor analysis of the promax rotation by the maximum likelihood method was conducted. KMO was confirmed to be greater than 0.50. Items with commonality less than 0.16 were rejected, and the minimum level of factor loadings was set at 0.40 or higher.

2.2.6. Confirmatory Factor Analysis

A confirmatory factor analysis was conducted to verify the goodness of fit of the model using a covariance structure analysis. IBM SPSS Amos (ver. 25) software was used for confirmatory factor analysis. Comparative fit index (CFI) and root mean square error of approximation (RMSEA) were used to determine the goodness of fit of the model. In this study, CFI = 0.9 or greater and RMSEA = less than 0.1 were considered a good fit. Goodness-of-fit index (GFI) and adjusted goodness-of-fit index (AGFI) were not used in this study because they are affected by the number of parameters and degrees of freedom [23] and are considered to be unstable indicators. The χ^2 (chi-square value), which is affected by the sample size, [23, 24] was used in combination with other indices to determine the goodness-of-fit. Similarly, Akaike's Information Criterion (AIC), although there is no absolute standard, is considered to be better when comparing multiple models with smaller values [25]. Consequently, this criterion was employed in conjunction with other indices to ascertain the degree of fit.

2.2.7. Examination of Reliability

As in the preliminary study, Cronbach's alpha coefficients for the entire questionnaire and for each factor were obtained to check the internal consistency reliability.

2.2.8. Validity Examination

The present study employed the methodology proposed by Nakamura [26] to assess the veracity of contemporary constructs by disregarding the consequential element as delineated by Messick's six criteria [27]. Specifically, this method examines the content aspect, the intrinsic aspect, the structural aspect, the generalizability aspect, and the external aspect [26]. The content aspect is the element that is not included in the construct to be measured.

The content aspect is defined as a domain that clearly delineates the elements that are included or not included in the construct to be measured, and indicates whether the content of the scale corresponds to or is sufficiently representative of the domain [26]. This is a method that uses the results of qualitative research to enable the listing of many items at the scale development stage, and which uses multiple experts to su-

pervise the selection of items at the item selection stage. In this study, we conducted a qualitative survey and received supervision from several experts to develop a draft scale. We judged that we had already adequately examined the content aspects of the scale. The intrinsic aspect indicates that there is a psychological rationale for the response process to the scale items [23]. This can be determined from the data based on the normal distribution, mean and standard deviation for each item, correlation analysis among items, and G-P analysis [26]. The structural aspect indicates that the structure of the data is consistent with the structure of the constructs [23]. This can be examined based on the results of exploratory research [24]. The generalizability aspect indicates that the interpretation of the obtained results is invariant among populations, occasions, periods of implementation, and similar item sets [23]. This can be determined using Cronbach's alpha coefficient [23, 24]. The external dimension is that the theoretically assumed pattern of correlations with other variables is actually exhibited [26]. This can be confirmed by determining "whether there are significant path coefficients between each construct and its indicator and whether the signs are all positive" [28] and "whether the correlation between the construct and its component items is greater than 0.5 and sufficiently large" [29]. This was examined by confirmatory factor analysis.

In addition, in order to verify construct validity, convergent and discriminant validity were tested. Convergent validity indicates that correlations are higher when the same characteristics are measured, while discriminant validity indicates that correlations are lower when different characteristics are measured [26]. This can be assessed by using the estimates extracted for each factor as a result of confirmatory factor analysis. Convergent validity was examined based on two criteria: CR (composite reliability) = 0.6 or higher [30, 31] and AVE (average variance extracted) = 0.5 or higher [31]. Similarly, discriminant validity was examined based on three criteria: inter-factor correlation \neq 1.0 [32], average shared square variance (ASV) must be less than AVE [31], and maximum shared squared variance (MSV) must be less than AVE.

2.3. Ethical Considerations

This study was conducted in accordance with the "Research Ethics Regulations of Miyagi University" and the "Ethical Guidelines for Medical Research Involving Human Subjects" of the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Health, Labor and Welfare, and was approved by the Research Ethics Special Committee of Miyagi University (Approval No. 611, Miyagi University; date of approval: July 31, 2017).

Table 1. Subject demographic data.

		(n=105)	
		n	%
Age	30s	38	(36.2)
	40s	67	(63.8)
Employment category	Construction	4	(4.8)
	Manufacturing	32	(30.5)
	Electricity, gas, heat supply, and water supply	2	(1.9)
	Information communications industry	1	(1.0)
	Transportation and postal services	9	(8.6)
	Wholesale and retail	1	(1.0)
	Finance and insurance	1	(1.0)
	Education and learning support	2	(1.9)
	Service industry	2	(1.9)
	Civil service and government	50	(47.6)
	Unknown	1	(1.0)
Number of Employees	Less than 100	14	(13.3)
	More than 100 but less than 300	23	(21.9)
	More than 300 but less than 1,000	33	(31.4)
	More than 1,000	34	(32.4)
	Unknown	1	(1.0)
Job type	Managerial	13	(12.4)
	Professional and technical	17	(16.2)
	Clerical	50	(47.6)
	Sales	2	(1.9)
	Service	1	(1.0)
	Production	15	(14.3)
	Transportation and driving	5	(4.8)
	Unknown	2	(1.9)
Employment status	Regular employee	105	(100.0)
	Temporary staff and contract employees	0	0.0
Marital status	Married	93	(88.6)
	Unmarried	12	(11.4)

		(n=105)	
		n	%
Highest level of education			
	High school	43	(41.0)
	Vocational school	8	(7.6)
	University	53	(50.5)
	Graduate school	1	(1.0)
Age when commencing smoking			
	Under 15 years old	2	(1.9)
	15 to 18 years old	13	(12.4)
	18 to 21 years old	75	(71.4)
	21 to 24 years old	5	(4.8)
	24 years old or older	10	(9.9)
Average number of cigarettes smoked per day			
	Less than 10	5	(4.8)
	More than 10 but less than 20	40	(38.1)
	More than 20	60	(57.1)
Smoking duration			
	Less than 5 years	3	(2.9)
	More than 5 years but less than 10 years	10	(9.5)
	More than 10 years but less than 15 years	39	(37.1)
	More than 15 years but less than 20 years	17	(16.2)
	More than 20 years but less than 25 years	25	(23.8)
	More than 25 years	11	(10.5)
Length of smoking abstinence			
	More than 6 months but less than 1 year	20	(19.0)
	More than 1 year but less than 5 years	29	(27.6)
	More than 5 years but less than 10 years	30	(28.6)
	More than 10 years	26	(24.8)
Number of previous attempts to quit smoking			
	None	46	(43.8)
	one	26	(24.8)
	two	13	(12.4)
	three times	9	(8.6)
	4 times	4	(3.8)
	5 times	4	(3.8)
	More than 10 times	3	(2.9)

3. Results

Consent was obtained from 54 organizations, and questionnaires were distributed to a total of 208 subjects, 134 of whom responded (response rate: 64.4%). Of these, 13 had visited a smoking cessation clinic, 3 had quit smoking less than 6 months prior to the study, and 13 were not in their 30s or 40s. 105 subjects were finally included in the analysis (valid response rate: 78.4%).

Table 2. Draft and Deleted Items from SCAPS.

		Mean		SD	Ceiling effect	Floor effect	I-T Correlation	(n=105) GP Analysis P Value
1	I had wanted to try to quit smoking for some time	2.733	±	1.031	3.764	1.702	.435	.000
2	I felt that that stopping smoking would be more beneficial	3.429	±	0.807	4.235	2.622	.443	.000
3	I was not willing to gradually reduce the number of cigarettes and stop	2.657	±	1.175	3.832	1.482	.421	.000
4	I always kept in mind that if I smoked, it would be the end of me	2.448	±	1.201	3.648	1.247	.596	.000
5	Tried to build on my efforts to quit smoking every day	2.519	±	1.199	3.718	1.321	.596	.000
6	I can't tolerate other people smoking at work	1.762	±	0.946	2.708	0.816	.312	.001
7	Smoking cessation has improved my reputation among people around me	2.010	±	0.872	2.881	1.138	.351	.001
8	I didn't have a strong desire to quit smoking*	2.686	±	1.146	3.832	1.540	.319	.000
9	Going to a smoking area became a hassle	2.139	±	1.123	3.261	1.016	.267	.001
10	I can now create an environment where I don't have to smoke, such as at home or in my car	3.067	±	1.085	4.152	1.981	.426	.001
11	I have learned to get through it if I can resist the urge to smoke for a few minutes	2.779	±	1.140	3.919	1.639	.587	.000
12	Told others I was quitting smoking	3.029	±	1.113	4.142	1.915	.444	.000
13	Increased involvement with non-smokers	1.743	±	0.832	2.575	0.910	.343	.008
14	Conscious striving to lose weight	2.200	±	1.004	3.204	1.196	.251	.013
15	Never thought about quitting smoking for health reasons*	2.229	±	1.179	3.407	1.050	.224	.046
16	Continued smoking became bothersome	2.462	±	1.079	3.540	1.383	.289	.018
17	The passage of time seemed longer	2.029	±	0.965	2.994	1.063	.344	.049
18	I am less likely to feel a strong urge to smoke	3.429	±	0.864	4.293	2.564	.332	.015
19	When I wanted to smoke, I changed my location and calmed myself down	1.914	±	0.931	2.846	0.983	.463	.000
20	Better concentration at work	2.286	±	0.968	3.254	1.318	.459	.000
21	Felt I should have quit smoking cigarettes earlier	2.533	±	1.057	3.590	1.477	.509	.000
22	I didn't have a clear reason to quit smoking*	2.490	±	1.269	3.760	1.221	-.020	.626
23	I couldn't get people close to me to approve of my smoking	1.798	±	0.918	2.716	0.880	.287	.021
24	I failed to quit smoking and didn't want people to	1.923	±	1.040	2.963	0.883	.551	.000

								(n=105)
		Mean	SD	Ceiling effect	Floor effect	I-T Correlation	GP Analysis P Value	
	point it out to me							
25	I can now perceive taste clearly	2.362	± 1.030	3.392	1.332	.427	.010	
26	When I wanted to smoke, I thought about something other than cigarettes to distract myself	2.124	± 1.089	3.213	1.035	.642	.000	
27	I no longer have to keep people waiting	2.240	± 1.110	3.351	1.130	.456	.005	
28	Proud of the hardest experience of my life	1.648	± 0.855	2.502	0.793	.517	.000	
29	Felt that cigarettes would eventually become unnecessary for me	2.510	± 1.024	3.534	1.486	.417	.000	
30	I expected to be disliked by others in the future	2.442	± 0.984	3.426	1.459	.521	.000	
31	I endured desperately trying to stay free of smoking	2.269	± 1.054	3.323	1.215	.644	.000	
32	Less time frustrated with wanting to smoke	2.733	± 1.068	3.801	1.666	.433	.000	
33	I distracted myself by eating gum or candy	2.429	± 1.091	3.519	1.338	.512	.000	
34	Cigarette-free situation is fresh and good	2.752	± 1.026	3.779	1.726	.599	.000	
35	I don't feel healthier after quitting smoking	2.529	± 1.052	3.580	1.477	.117	.037	
36	The places where I can smoke at work have been reduced	3.442	± 0.868	4.311	2.574	.371	.004	
37	I have several overlapping reasons to quit smoking	2.924	± 1.062	3.986	1.861	.478	.000	
38	I got through it with a strong will to quit smoking	2.933	± 1.077	4.010	1.857	.603	.000	
39	I am no longer distracted by the strong urge to smoke	3.124	± 0.917	4.040	2.207	.486	.008	
40	When I wanted to smoke, I took something to hold me over	2.133	± 0.991	3.124	1.142	.701	.000	
41	Improved physical condition	2.533	± 0.910	3.443	1.623	.496	.000	
42	The social environment has become difficult for smokers	3.569	± 0.682	4.251	2.886	.312	.001	
43	I knew stopping smoking was hard	2.867	± 1.057	3.923	1.810	.628	.000	
44	I didn't smoke because I remembered the painful experience right after I quit smoking	2.117	± 1.022	3.139	1.094	.571	.000	
45	I now have the prospect of continuing being abstinent from smoking	3.210	± 0.906	4.116	2.303	.424	.003	
46	Become stricter on tobacco etiquette	3.000	± 0.961	3.961	2.039	.479	.000	
47	It is a great way to save money.	1.790	± 0.817	2.607	0.974	.440	.000	
	Entire scale	118.110	21.426					

* is a reverse-keyed item

Dark shading in the table indicates items excluded from the item analysis

Light shading in the table indicates items excluded in the exploratory factor analysis

3.1. Summary of Subjects (Table 1)

A slightly larger proportion of the subjects (63.8%) were in

their 40s. The most common age of starting smoking was between 18 and 21 years old (71.4%), and the most common average number of cigarettes smoked per day was 20 or more (57.1%). 37.1% of the smokers had been smoking for between

10 and 15 years. The duration of smoking cessation was distributed similarly across time bands, with 28.6% of the respondents abstaining from smoking for 5 to 10 years, 27.6%

for 1 to 5 years, and 24.8% for more than 10 years. 43.8% of respondents had never tried to quit smoking prior to their cessation of smoking.

Table 3. Results of Exploratory Factor Analysis of SCAPS.

		Factor		
		1	2	3
Factor 1 [Status of response to smoking cravings]				
31	I endured desperately trying to stay free of smoking	.855	-.055	.011
44	I didn't smoke because I remembered the painful experience right after I quit smoking	.714	.020	-.133
26	When I wanted to smoke, I thought about something other than cigarettes to distract myself	.686	.207	-.074
43	I knew stopping smoking was hard	.604	.022	.136
5	Tried to build on my efforts to quit smoking every day	.594	-.254	.391
17	The passage of time seemed longer	.586	.142	-.237
4	I always kept in mind that if I smoked, it would be the end of me	.534	-.078	.274
32	Less time frustrated with wanting to smoke	.506	.099	-.051
40	When I wanted to smoke, I took something to hold me over	.489	.223	.149
Factor 2 [Perceived benefits associated with successful smoking cessation]				
20	Better concentration at work	-.114	.724	.061
41	Improved physical condition	.198	.582	-.098
46	Become stricter on tobacco etiquette	.078	.575	-.117
25	I can now perceive taste clearly	.186	.518	-.132
34	Cigarette-free situation is fresh and good	.117	.498	.266
Factor 3 [Positive perception of smoking cessation]				
8	I didn't have a strong desire to quit smoking (R)	.068	-.214	.622
1	I had wanted to try to quit smoking for some time	-.152	.092	.614
37	I have several overlapping reasons to quit smoking	.078	-.049	.596
21	Felt I should have quit smoking cigarettes earlier	-.131	.448	.488
29	Felt that cigarettes would eventually become unnecessary for me	-.127	.339	.434
Cronbach's α (full scale) = .876				
Inter-factor correlations		.873	.759	.702
Factor 1		1.000		
Factor 2		.334	1.000	
Factor 3		.515	.367	1.000

Factor extraction method: Maximum Likelihood Method (Promax Method)

R is a reverse-keyed item

3.2. Item Analysis (Table 2)

The results for each scale item are presented in terms of

mean and standard deviation, and the well effect, floor effect, and distribution of scores were confirmed. As a result, seven items corresponded to the ceiling effect, five items to the floor effect, one item to the G-P analysis, and seven items to the I-T

correlation analysis. Although a slight floor effect was observed for item "46. Stricter tobacco etiquette", it was not removed due to other analysis results. No items were found to meet the exclusion criteria in the correlation analysis among the items. A total of 19 items were rejected because of item overlap.

3.3. Results of Exploratory Factor Analysis (Table 3)

Excluding the 19 items from the initial 47 items identified for removal after the item analysis, 28 items were included in the factor analysis. MAP and SMC of these 28 items were confirmed by the factor numbering method, and the number of factors identified was 3. KMO was 0.80, which indicated a reasonable sample. In the first round, a three-factor structure was used based on an eigenvalue of 1 or higher. The results indicated that a three-factor structure consisting of 19 items was appropriate.

Factor I was named "Status of coping with smoking cravings" because it consisted of items that indicated the thoughts and actions of successful quitters who had a strong and creative will to quit smoking throughout the process of deciding to quit, quitting, and maintaining abstinence. Factor II was named "Feeling of benefits associated with quitting smoking" because it consisted of items related to the various benefits that successful quitters felt they had acquired after quitting smoking and changes in their attitudes towards smoking and quitting smoking. Factor III included "8. Did not strongly want to quit smoking" which was a reverse keyed item. This analysis has led to the designation of the factor in question as

"Positive perceptions of quitting smoking." This designation reflects the composition of the factor, which is comprised of items indicating that successful quitters have a positive perception of quitting smoking due to the combination of multiple reasons for quitting smoking and a desire to try to quit smoking.

3.4. Results of Confirmatory Factor Analysis

The three factors and 19 items obtained in the exploratory factor analysis were used as the final model. A structural model of the correlations among the factors was constructed, and the fit of the data to the model was verified by confirmatory factor analysis. The results showed that the goodness-of-fit indices were CFI = 0.86 and RMSEA = 0.079, and that CFI of the hypothetical model did not meet the statistically acceptable level. Therefore, question 8, for which the standardized estimate of the path coefficient was less than 0.5, was rejected and the remaining 18 items re-analyzed in the same way. The results were CFI = 0.87 and RMSEA = 0.079, indicating that the hypothesized model still did not meet the statistically acceptable CFI. Question 37, for which the standardized estimate of the path coefficient was less than 0.5, was removed and the remaining 17 items were re-analyzed. The results showed that CFI = 0.90 and RMSEA = 0.071, which supported the exploratory factor analysis for the 17 remaining items. (Figure 1)

Table 4 shows the scale items based on the results of confirmatory factor analysis.

Table 4. Scale Items of SCAPS.

Status of response to smoking cravings	
Q31	I endured desperately trying to stay free of smoking
Q44	I didn't smoke because I remembered the painful experience right after I quit smoking
Q26	When I wanted to smoke, I thought about something other than cigarettes to distract myself
Q43	I knew stopping smoking was hard
Q5	Tried to build on my efforts to quit smoking every day
Q17	The passage of time seemed longer
Q4	I always kept in mind that if I smoked, it would be the end of me
Q32	Less time frustrated with wanting to smoke
Q40	When I wanted to smoke, I took something to hold me over
Perceived benefits associated with successful smoking cessation	
Q20	Better concentration at work
41	Improved physical condition
Q46	Become stricter on tobacco etiquette
Q25	I can now perceive taste clearly

Q34	Cigarette-free situation is fresh and good
Positive perception of smoking cessation	
Q1	I had wanted to try to quit smoking for some time
Q21	Felt I should have quit smoking cigarettes earlier
Q29	Felt that cigarettes would eventually become unnecessary for me

3.5. Examination of Reliability

Cronbach's alpha coefficients were obtained for the entire questionnaire and for each factor. The alpha coefficient for the entire questionnaire was 0.873, and that for each factor was 0.873 for Factor I, 0.759 for Factor II, and 0.658 for Factor III.

3.6. Validity Examination

Nakamura [26] showed how to exclude the consequential aspect from Messick's [27] six requirements and, as previously discussed, the content aspect had already been confirmed. The intrinsic aspect was confirmed by the results of the item analysis. The structural aspect was confirmed by the results of exploratory and confirmatory factor analysis. The generalizability aspect was confirmed by examining the in-

ternal reliability of the scale. For the external aspect, the results of confirmatory factor analysis showed that there were significant path coefficients between the constructs and their indicators, that the signs were all positive, and that the correlation between the constructs and their constituent items was greater than 0.5 (Figure 1).

The confirmatory factor analysis produced CR=0.9 for Factor I, CR=0.9 for Factor II, and CR=0.8 for Factor III, indicating that CR=0.6 or higher for all factors. However, AVE=0.4 for each factor, which did not meet the criterion of AVE=0.5 or higher. Regarding discriminant validity, the inter-factor correlation between Factors I and II was 0.5, between Factors II and III was 0.7, and between Factors I and III was 0.4, indicating that the inter-factor correlation was $\neq 1.0$ for all factors. ASV = 0.3 and MSV = 0.5, confirming that ASV was lower than AVE, but not that MSV was lower than AVE.

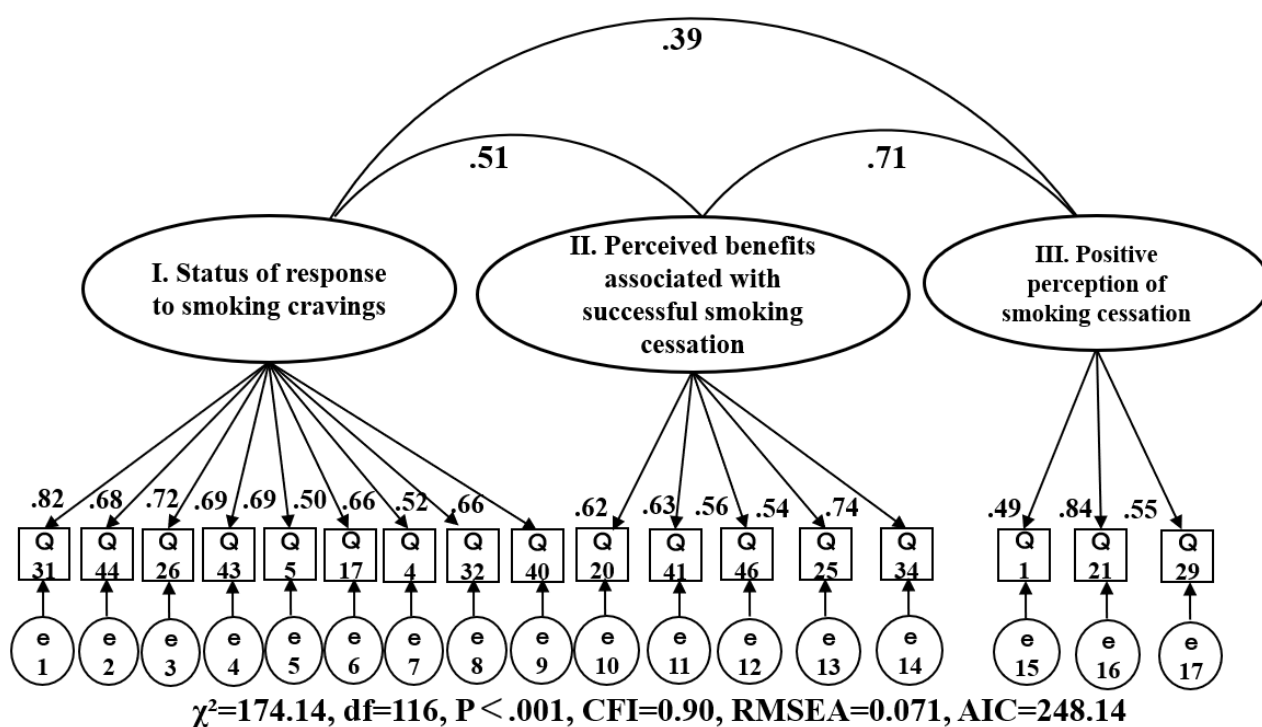


Figure 1. Confirmatory factor analysis of SCAPS.

4. Discussion

The objective of this study was to develop a scale, designated the Smoking Cessation Assessment of Progress Scale (SCAPS), for the assessment of smoking cessation efforts among adult mid-adulthood male workers who smoke. The reliability and validity of the scale were also examined.

An exploratory factor analysis of the preliminary survey revealed that the 118 items of the proposed scale could be reduced to 47 items with a seven-factor structure. Exploratory factor analysis of the main survey resulted in a 19-item scale with a three-factor structure. Finally, confirmatory factor analysis produced a three-factor structure with 17 items. These three factors were identified as "Response to smoking cravings," "Perceived benefits of quitting smoking," and "Positive perceptions of quitting smoking."

The reliability of the scale was confirmed by calculating Cronbach's alpha coefficient. In the preliminary study, the reliability of the scale as a whole and for each of the factors was confirmed, with the exception of Factor VII. The reason for the low reliability of Factor VII was that it consisted of three items and the factor loadings were not very high (0.472 to 0.419). However, in the preliminary survey, the number of items to be rejected was kept to a minimum and as many items as possible were retained, so that the items could be carefully sorted in the analysis in the main survey. In this survey, the reliability of the scale as a whole and for each factor was found to be acceptable. Therefore, it can be said that the reliability of the scale was verified.

Regarding the validity of the scale, a slight negative correlation was found with the KTSND [20], but it was not significant. However, a slightly significant negative correlation was found for Factors II and V. The reason for this is that the higher the level of nicotine dependence, the higher the score on the KTSND [20]. Therefore, as the subjects in this study had succeeded in quitting smoking and had overcome their nicotine dependence, a lower score would be expected, as would a negative correlation with this scale. However, a previous study by the authors revealed that some smokers retained memories of smoking and a desire to smoke after quitting [16], suggesting that they may not have completely overcome their nicotine dependence after quitting smoking. Thus, a significant negative correlation was not found with this scale. However, a significant positive correlation was found with the CSS-21 [19]. Based on these results, it can be said that the construct validity of the scale was verified in the preliminary survey.

In this study, convergent and discriminant validity were examined using the method proposed by Nakamura [26] to exclude consequential aspects from Messick's [27] six requirements and the estimates for each factor were extracted as a result of confirmatory factor analysis. In order to ascertain the participating organizations' perceptions of the study, as well as to identify any additional preparations that might be necessary, and to determine their willingness to participate in

subsequent studies, a preliminary survey was conducted. This involved visits to the participating organizations, during which written and oral explanations of the study were provided. Many of the participating organizations expressed a desire for the questionnaire to be simplified in order to reduce the burden on the subjects. The "Ethical Guidelines for Medical Research Involving Human Subjects" issued by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Ministry of Health, Labour and Welfare (MHLW) stipulates that "researchers, etc., should consult with, inquire about, and explain to research subjects or their representatives, etc. (hereinafter referred to as "research subjects, etc.") and their related persons. Consequently, in order to streamline the questionnaire to the greatest extent possible, a validation process was conducted in accordance with the guidelines outlined in this report, taking into account the principles of research ethics.

As a result, the content aspect, intrinsic aspect, structural aspect, generalizability aspect, and external aspect described by Messick [27] were confirmed. Furthermore, one of the two criteria for convergent validity and two of the three criteria for discriminant validity were met. Based on these results and the results of the preliminary study, it can be argued that, in addition to the reliability of the scale, construct validity of the SCAPS, has also been generally verified.

Currently, a smoking history is collected during the periodic health examinations of workers [33]. By including the SCAPS as part of the medical questionnaire, it will be possible to ascertain not only the subject's smoking history but, if a smoker, also the current status of their efforts to quit smoking, as well as indicators of what support is needed. Specifically, the status of progress towards smoking cessation by smokers can be ascertained in the items related to Factor I, "Response to smoking cravings." If the number of "agree" or "somewhat agree" responses to these items is low, the subject is likely not in control of their smoking cravings and can be considered at high risk of resuming smoking. Therefore, other smoking cessation methods, such as attending outpatient smoking cessation clinics and the use of over-the-counter smoking cessation medications, should be suggested and discussed with the subject. Similarly, the degree of interest in quitting smoking can be ascertained from the items related to Factor III, "Positive perception toward smoking cessation." For those who are currently trying to quit smoking and have been able to continue making progress towards abstinence, progress can be ascertained using the items related to Factor II, "Feeling of benefits associated with quitting smoking."

Furthermore, when analyzing the results of health checkups for an entire office or organization, the SCAPS enables a more detailed understanding of the status of efforts to quit smoking among mid-adulthood male workers, in addition to their smoking history. This will lead to more effective support for smoking cessation and may lead to an increase in the number of smokers who successfully quit smoking in the workplace in the future. It has been noted that smokers have lower produc-

tivity than nonsmokers, and it has been shown that quitting smoking improves productivity to the same level as non-smokers [34]. In other words, it is possible that the more smokers who successfully quit smoking, the more productivity in the organization as a whole will increase.

By using the SCAPS developed in this study to assess smoking cessation efforts among mid-adulthood male smokers, occupational health professionals can accurately assess smokers' current smoking cessation efforts and provide appropriate support when providing smoking cessation support in the workplace.

Smoking cessation support for mid-adulthood male workers is also provided outside the workplace at locations including smoking cessation outpatient clinics, pharmacies, and government agencies. In the future, the SCAPS can be expected to be widely used by public health nurses and professionals other than public health nurses to support smoking cessation in these various settings.

In order to properly utilize the SCAPS for actual support in the field, a support manual will need to be prepared and specific usage and evaluation practices should be verified.

The study also revealed that most subjects had started smoking between the ages of 18 and 21. In addition, most subjects had been smoking for more than 10 years. In other words, the subjects started smoking at a relatively early age after graduating from high school, entering higher education, or finding employment, and continued to smoke for a long time. Smoking is not easy to quit once started due to nicotine dependence. In addition, there are often many smokers in the social networks to which the smoker belongs, and this social environment may also make it difficult for a smoker to quit [35]. The results of this study support the idea that it is important to provide support to young people so that they do not start smoking, and that it is also important to provide smoking cessation support to smokers at an early stage.

5. Conclusions

The objective of this study was to develop and test the reliability and validity of the SCAPS. It was based on the results of a qualitative inductive analysis of the characteristics of successful smoking cessation efforts among midlife adult male workers in a previous study by the authors. Subjects were men in their 30s and 40s who were employed, had quit smoking for at least six months, and had successfully quit without seeking outpatient smoking cessation treatment.

After a pre-survey, the main survey was administered, followed by confirmatory factor analysis, which resulted in the identification of three factors and 17 items.

Cronbach's alpha coefficients for each subscale were generally good, ensuring reliability. Construct validity was generally ensured by the confirmatory factor analysis and the estimates extracted from the results for each factor.

It is expected that the SCAPS will enable occupational

health professionals, when providing smoking cessation support, to accurately assess the current cessation efforts of midlife adult male smokers and provide support accordingly.

In the future, further research should be conducted on the effective use of it in various fields of public health, including the field of occupational health.

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Conflicts of Interest

The authors declare no conflicts of interest.

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