The development and initial validation of the smoking policy inventory

Wayne F Velicer, Robert G Laforge, Deborah A Levesque, Joseph L Fava

Abstract

Objective **– Typically, measurement of smoking policy involves the use of a series of individual items that vary in number and kind from study to study. This paper reports on the development and initial validation of a psychometrically sound inventory designed to measure major dimensions of smoking policy for use in population surveys and evaluation of community intervention trials.**

Design **– Inventory development followed a variation of the sequential method of scale construction. This included qualitative analyses (literature reviews, focus groups, item generation, and expert review) and quantitative analyses (item analysis, principal component analysis, confirmatory analysis, and validation on a second sample).**

Results **– A five-dimensional model for smoking policy and a short 35-item smoking policy inventory were developed and confirmed on a second sample. The five scales are: (*a*) advertising and promotion; (*b*) public education; (*c*) laws and penalties; (*d*) taxes and fees; and (*e*) restrictions on smoking. Internal validity was demonstrated by differences in the predicted directions with respect to (*a*) current smoking status; (*b*) smoking history; (*c*) sensitivity to smoke; (*d*) the smoking status of friends; and (*e*) current stage of change.**

Conclusions **– The smoking policy inventory is a valid instrument that allows for comparisons across samples and over time. Its potential applications include use as an outcome measure for intervention trials, an assessment of both within- and between-sample differences, a mechanism to tailor interventions, and an instrument for epidemiologic surveillance of smoking policy trends.**

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Cancer Prevention Research Consortium, University of Rhode Island, Kingston, Rhode Island, USA
WF Velicer
RG Laforge
DA Levesque
JL Fava

Correspondence to WF Velicer, Cancer Prevention Research Center, Flagg Road, University of Rhode Island, Kingston, RI 02881-0808, USA (BITNET: KZP101 @ URIACC).

Smoking cessation can focus either on the individual or attempt to alter the environment in which the smoker exists. Evaluation of the environmental interventions has typically relied on distal measures relating to the level of tobacco use. This paper discusses the development of and some initial validity evidence for the Smoking Policy Inventory (SPI), a short questionnaire designed to be a sensitive proximal assessment instrument. Such a measure can guide development, implementation, and evaluation of public health policy interventions.

The excessive health risks and exorbitant social costs associated with smoking and involuntary tobacco smoke exposure are increasingly seen as important factors shaping social policy in the US and around the world. In 1986, the World Health Assembly endorsed a resolution designed to protect nonsmokers from involuntary exposure to tobacco smoke, and restrictive legislation has been passed in France, New Zealand, Australia, and the US, among others. During the last decade, the "nonsmokers' rights" movement (opposed by its counterpart, the "smokers' rights" movement) has developed smoking restrictions. Total bans can now be found in many public places, workplaces, and places of entertainment. Federal agencies, state governments, and private organisations are passing new laws regulating smoking and involuntary exposure to tobacco smoke. Restrictive smoking and tobacco policies are themselves increasingly seen as a favoured mechanism used by policy makers to sway public opinion about smoking and tobacco policy. Support for these approaches requires evidence that smoking policies can affect smoking behaviour. For example, smokers working in companies with restrictive worksite smoking policies have been found to reduce their smoking.[1] Recent public opinion polls report widespread support for "sin" taxes, or user fees, on tobacco products as one means of providing dis-incentives for use while off-setting the high health costs associated with chronic smoking.[2]

Clearly, the nature of the smoking policy environment is rapidly changing. There is a general consensus emerging among policy makers that the harmful individual and social costs of smoking to society must be reduced by concerted efforts to change public policy. How much public support there is for changing smoking policy remains a matter of some speculation, varying from poll to poll and policy to policy. How smoking policies should be implemented is perhaps even more controversial.

Assessment of public opinion about smoking policies is itself an important part of the process of policy development and implementation. For example, restaurant owners tend to favour self-regulation over legislative approaches to the provision of smoke-free areas.

However, owners who know that their customers prefer nonsmoker areas are more likely to have them in their restaurants.[3] Moreover, health insurance companies have been reluctant to provide coverage for smoking cessation, and are not likely to change this approach in the absence of evidence of public demand for such a product.[4]

There is no established measure for attitudes and opinions about smoking policy. Previous studies have relied on single items which have varied from study to study, making comparisons across studies or during different historical periods impossible. The assessments have often been limited in scope, such as assessing whether or not a policy exists. One of the more comprehensive assessments in a survey of a representative sample is the 1990–91 survey of tobacco use in California.[2] However, even in this study, the data were analysed as a series of items. Analysing individual items presents many drawbacks. Slight wording changes can result in large differences in meaning and in response patterns. Individual items are often not reliable. If a comprehensive assessment of the area is made, the large number of items generated makes subsequent analysis complex and difficult to interpret.

An alternative approach that has been extremely successful in a wide variety of areas is to develop a conceptual model based on a limited number of general constructs. Formal conceptual models can provide an organising framework for the study of a content area. A construct can serve to organise a set of items, and a limited number of constructs can organise and define a content area.[5] It is possible to determine if an inventory includes items that assess all the important dimensions and excludes items that are either redundant or irrelevant. Item composites replace single items in any analysis and such composites are much more reliable than single items. Broad constructs can be assumed to generalise to unmeasured items that belong to that construct. In the psychometric literature, general constructs are referred to as factors or latent variables.

The method of inventory development used in this study followed a variation of the sequential method of scale construction.[6–8] This involves generating a large item set which reflects a tentative set of pre-specified dimensions. A qualitative review of the item pool by a team of experts and representatives of the target population assures meaningfulness and reliability. Administration to an initial sample of subjects serves to assess the adequacy of the proposed dimensions. This initial administration also provides the basis for a quantitative review of the item set, revision of some items, and a reduction of the initial pool of items. A second administration provides a confirmatory analysis of the structure. Variables not in the item pool form the basis for a series of external validity studies. This paper reports the development of the inventory, a confirmatory study, and some initial external validity analyses.

Potential applications of the SPI include use as: (*a*) an outcome measure for intervention trials; (*b*) an assessment of both within and between-sample differences; and (*c*) a preliminary assessment to tailor the development of interventions to the profile of a particular group. The development of a formal measurement instrument can result in comparability across studies and the assessment of changes over time.

Study 1 Development of the Smoking Policy Inventory

METHOD

Item generation

A review of available policy items from sources like the California Tobacco Use Survey,[2] and a review of the literature[1–4] guided the initial definition of eight broad categories of smoking policy: (1) *protection of minors*, (2) *user fees*, (3) *product safety and design*, (4) *protection of nonsmokers/clean air*, (5) *protection of smokers' rights*, (6) *changing social norms and social behaviours*, (7) *marketing restrictions*, and (8) *tobacco company regulations*. The categories were a tentative organisation based on a content analysis by the authors. This initial categorisation was necessary because no formal model was available for this area. We tried to define broadly the different types of policy changes that could be adopted to curb smoking and limit others' exposure to second-hand smoke with a set of categories comprehensive enough to include all items that were available to us.

A 10-person focus group consisting of health psychologists, graduate and undergraduate students, and full-time staff from our research centre convened to generate as many items as possible within each of the eight postulated categories. The members of the focus group had varying levels of expertise in the area of smoking cessation research and smoking policy. All generated items employed a 5-point Likert-type response format (1 = disagree completely to 5 = agree completely). A total of 227 items were generated, with an average of 28 items in each of the eight categories. From this pool of 227 items, 116 items were selected for administration based on a qualitative review. Selection was on the basis of clarity, simple expression of the idea, lack of redundance with other selected items, and representativeness of the conceptual definitions of a single dimension.

Subjects

The first sample consisted of 204 undergraduate students, 120 women and 84 men, enrolled in an introductory-level psychology course at the University of Rhode Island. This is an adequate sample size for the analysis.[9,10] The majority of subjects were white and unmarried, and all were at least 18 years of age. Subjects received extra credit points in exchange for their participation. After completing the forms, one subject was deleted because of missing data.

Procedure

The 116 SPI items were arranged in random order, and administered as part of a survey that included other smoking-related questions. These other questions measured: 1) present smoking behaviour, 2) smoking history, 3) extent bothered by cigarette smoke, 4) number of friends who smoke, 5) parents' smoking history, 6) knowledge about smoking restrictions, and 7) knowledge about the hazards associated with second-hand smoke. In addition, the Stages of Change from the Transtheoretical Model of Behaviour Change was assessed for smoking subjects.[11–13] Smokers who did not plan to change their smoking behaviour within the next six months were classified in the precontemplation stage; those who were seriously considering quitting within the next six months were classified in the contemplation stage; individuals who quit smoking within the last six months were classified in the action stage; and those who quit more than six months ago were classified in the maintenance stage.

Principal component analysis (PCA) with varimax rotation was performed on the 116 x 116 matrix of SPI inter-item correlations as a first step in item refinement and to examine the proposed dimensionality of the SPI.[14] The MAP procedure and a parallel analysis approximation procedure were employed to determine the number of components to retain.[15,16] These are two of the most accurate procedures available.[17,18] Component interpretability, the correlations between the individual items and components (loadings), and the Cronbach's coefficient alphas for the new subscales with and without particular items included determined the final number and composition of the components. Complex items (items with loadings >0.40 on two or more components), items with low loadings (<0.40 on all components), and items that contributed negatively to the reliability of a subscale were deleted. A decision was made to retain only the best seven items for each scale. This represents a compromise between designing short scales which reduce the response burden on subjects and the competing desire to have an extensive sample of items from each of the dimensions of smoking policy.

RESULTS

Internal validity

Optimal results were achieved for a five-component solution. Only the principal components analysis which was performed on the refined 35 x 35 matrix of inter-item correlations representing the final version of the new SPI is reported here. All items loaded heavily on their respective components (average loading = 0.71), and did not load heavily on other components (average loading = 0.16), indicating good convergent and divergent internal validity. These five components account for 63% of the total variance.

Table 1 lists the 35 retained items and the varimax rotated component pattern. The first component was labelled *advertising and promotion*. The seven items involve recommendations that cigarette advertising and promotions be restricted to make smoking less appealing. The second component was labelled *public education*. The seven items involve various methods of educating people about the health risks of smoking, the risks of second-hand smoke, and ways to stop smoking. The third component was labelled *laws and penalties*. The seven items deal with the enforcement of laws that treat cigarettes as a controlled substance, for example, requiring a license to sell cigarettes, and enforcing penalties against store owners and minors who break laws prohibiting the sale of cigarettes to minors. The fourth component was labelled *taxes and fees*. The seven items are concerned with recommending increases in taxes and fees for the purchase, advertising, and production of tobacco products as a way to curb cigarette consumption and production. The fifth component was labelled *restrictions on smoking*. The seven items deal with the restriction of cigarette smoking in the workplace, public buildings, and other areas.

Several of the original eight categories of smoking policy used to guide item generation were retained in the refined five-scale SPI. The original *marketing restrictions*, *changing social norms and social behaviours*, and the *protection of minors* categories are comparable to the *advertising and promotion*, *public education*, and *laws and penalties* scales, respectively, on the finalised SPI. Items initially generated for both the *protection of smokers/clear air* and *protection of smokers' rights* categories were combined to form the *restrictions on smoking* scale on the SPI. Taxation-related items are drawn from several of the original categories and together comprise the *taxes and fees* scale. The original *product safety and design* category is the only category not represented in the final SPI.

A scale score corresponding to each of the five empirically derived components was obtained by calculating the unweighted sum of each of the seven items forming the individual scales. Items with negative loadings were reflected before summation. The means and standard deviations for the five scales are presented in table 2.

Cronbach coefficient alphas were calculated for each of the five scales and the correlation coefficients were computed between scores (see table 2). Alpha coefficients ranged from 0.83 to 0.92, indicating high internal consistency. The magnitude of the correlations between the scales, which range from 0.39 to 0.67, indicates the presence of at least one second-order factor. Explanations for the correlations among the five scales of the SPI will be examined in the next study (see below).

External validity

The second major set of analyses evaluated the external validity of the new SPI. Seven independent or grouping variables were examined to evaluate the external validity of the five scales. The grouping variables were: (1)

Table 1 Items by scale and varimax pattern for the Smoking Policy Inventory items

	Component				
	1	*2*	*3*	*4*	*5*
Scale I Advertising and promotion					
Tobacco products should not be advertised at the front of a store	**0.76**	0.05	0.14	0.20	0.17
Tobacco companies should not be allowed to offer promotional items (t-shirts or free cigarettes) to encourage the purchase of cigarettes	**0.71**	0.11	0.12	0.21	0.15
Tobacco advertising should not be allowed to make cigarette smoking look relaxing or fun	**0.70**	0.19	0.15	0.19	0.15
Cigarette advertising on billboards and in the media should be banned	**0.79**	0.05	0.17	0.20	0.06
Advertising cigarettes on shirts, jeans, and other clothing should be banned	**0.75**	0.05	0.18	0.21	0.20
Advertising tobacco products at sports and athletic events should be banned	**0.65**	0.23	0.16	0.30	0.15
All cigarette advertising should be banned	**0.78**	0.08	0.19	0.30	0.14
Scale II Public eduction					
The federal government should provide funding to help promote stop-smoking techniques	0.18	**0.62**	0.15	0.12	0.02
Parents should be educated about the dangers of second-hand smoke to children	−0.10	**0.69**	0.07	0.02	0.07
Physicians should educate their patients about the health risks of smoking	0.07	**0.80**	0.06	0.14	0.04
New mothers should have to undergo training on the health risks of smoking for themselves and for their children	0.24	**0.58**	0.01	0.10	0.01
Public places that allow smoking should be required to post a sign warning of the health hazards of smoking	0.14	**0.58**	0.19	0.24	0.30
Physicians should educate their patients about the health benefits of not smoking	0.10	**0.73**	0.17	0.18	0.08
The dangers of second-hand smoke should be publicized	0.06	**0.76**	0.13	0.05	0.16
Scale III Laws and penalties					
Minors caught buying cigarettes should be fined	0.17	0.10	**0.67**	0.12	0.31
People who sell cigarettes to minors should be prosecuted	0.12	0.11	**0.73**	−0.03	0.29
Local police should strongly enforce laws against tobacco sales to minors	0.06	0.15	**0.74**	0.12	0.26
Laws should impose financial penalties for the sale of tobacco products to minors	0.14	0.12	**0.81**	0.08	0.19
A license should be required to sell cigarettes	0.19	0.11	**0.66**	0.26	−0.02
Store owners should need a licence to sell cigarettes (just like alcoholic beverages)	0.25	0.03	**0.70**	0.28	0.07
Penalties should be gradually increased for store owners who repeatedly sell cigarettes to minors	0.17	0.29	**0.77**	0.03	0.21
Scale IV Taxes and fees					
The costs of cigarette advertising should be increased to discourage manufacturers from advertising	0.35	0.07	0.05	**0.60**	0.18
The government should increase capital gains taxes on tobacco products as a way of curbing tobacco production	0.23	0.08	0.16	**0.69**	0.25
Taxes on cigarettes should be increased to discourage smoking	0.14	0.14	0.07	**0.83**	0.29
The government should place a large tax on cigarette advertising	0.33	0.17	0.10	**0.69**	0.16
Taxes on cigarettes should be increased to prevent youth from starting to smoke	0.19	0.23	0.21	**0.78**	0.20
Taxes on cigarettes should be increased to pay for smoking-related health care costs	0.29	0.24	0.15	**0.72**	0.04
The federal tax rate on cigarettes should be increased	0.33	0.12	0.14	**0.73**	0.31
Scale V Restrictions on smoking					
Smoking should be banned in all restaurants and cafeterias	0.24	0.07	0.22	0.27	**0.66**
Smoking in public places should be illegal	0.14	0.12	0.24	0.14	**0.73**
Smoking should be banned in all public buildings	0.24	0.17	0.23	0.17	**0.76**
All work sites should be smoke-free	0.20	0.09	0.22	0.23	**0.69**
Smokers should be allowed to smoke in public buildings	−0.08	−0.15	−0.20	−0.16	**−0.78**
Smokers should be able to smoke at work sites	0.01	0.05	−0.05	−0.21	**−0.73**
Smoking should be banned on all public transportation	0.36	0.23	0.17	0.09	**0.56**

Note: All values above 0.40 are printed in bold type. For scoring purposes, the bold type loadings indicate assignment to a scale. Negative loadings items should be reflected before summing the items.

Table 2 Means, standard deviations, coefficient alphas, and scale intercorrelations for five scales

Scale	Mean	SD	Alpha	Scale correlations 1	2	3	4
Advertising and promotion	20.47	7.70	0.91	—			
Public education	30.18	4.65	0.83	0.39	—		
Laws and penalties	24.58	7.21	0.90	0.49	0.41	—	
Taxes and fees	23.52	7.88	0.92	0.67	0.42	0.43	—
Restrictions on smoking	23.84	7.70	0.90	0.53	0.40	0.55	0.57

smoking status; (2) smoking history; (3) number of friends who smoke; (4) extent bothered by cigarette smoke; (5) stage of change (smokers only); (6) parents' smoking history; and (7) knowledge about the health hazards of smoking. A multivariate analysis of variance (MANOVA) was conducted for each of the grouping variables with the five SPI scales serving as dependent variables. The MANOVA resulted in significant differences among groups derived on the basis of: (1) smoking status (Wilks' Lambda = 0.76585, approximate $F(5,168) = 10.27, p<0.001$); (2) smoking history (Wilks' Lambda = 0.78296, approximate $F(5,165) = 9.15$, $p<0.001$); (3) number of friends who smoke (Wilks' Lambda = 0.74259, approximate $F(20,538) = 2.52$, $p<0.001$); (4) extent bothered by cigarette smoke (Wilks' Lambda = 0.48530, approximate $F(10,334) = 14.54$, $p<0.001$); and (5) stage of change for smoking cessation (Wilks' Lambda = 0.60480, approximate $F(15,141) = 1.88$, $p<0.05$). There were no significant differences for groups based on parents' smoking history or knowledge about the hazards of smoking. The results of follow-up univariate analyses of variance (ANOVAs) and Newman-Keuls multiple comparisons tests are summarised in table 3.

Nonsmokers scored significantly higher than smokers on the five SPI scales, with the greatest difference on the last two scales (figure 1). A similar pattern exists for the comparison between subjects who never smoked compared to subjects with a smoking history. There is considerable overlap in these two grouping variables

Differences between subjects occurred with respect to the degree to which they are bothered by cigarette smoke (figure 2). As might be predicted, subjects who are "quite a bit bothered" by cigarette smoke scored sig-

Table 3 Smoking policy inventory scores as a function of smoking history

Scale	Smokers	Non-smokers				F value	η^2	Newman–Keuls
Part I Present smoking behaviour*								
Advertising and promotion	16.7	21.3				9.72	0.05	
Public education	28.1	30.8				9.86	0.05	
Laws and penalties	20.0	25.6				17.87	0.09	
Taxes and fees	17.0	24.7				28.06	0.14	
Restrictions on smoking	16.8	25.8				42.91	0.20	
Part II Smoking history*								
Scale	YES	NO						
Advertising and promotion	18.4	21.7				7.33	0.04	
Public education	29.2	30.8				4.73	0.03	
Laws and penalties	22.0	25.9				11.69	0.07	
Taxes and fees	19.1	25.5				29.18	0.15	
Restrictions on smoking	19.7	26.2				32.99	0.16	
Part III Extent bothered by smoke*								
Scale	Not at all	A little	Quite a bit					
Advertising and promotion	14.1	18.8	23.0			16.98	0.17	1 < 2 < 3
Public education	26.4	29.4	31.7			17.41	0.17	1 < 2 < 3
Laws and penalties	16.4	22.7	27.6			35.72	0.30	1 < 2 < 3
Taxes and fees	14.7	21.7	26.4			28.63	0.25	1 < 2 < 3
Restrictions on smoking	13.3	21.5	28.0			70.09	0.45	1 < 2 < 3
Part IV Number of friends who smoke*								
Scale	0	1–2	3–4	5–6	> 6			
Advertising and promotion	27.8	21.2	20.8	18.4	17.1	6.77	0.14	1 > 2 > 3, 4, 5
Public education	33.4	31.2	30.1	29.0	29.0	3.91	0.09	1 > 2 > 3, 4, 5
Laws and penalties	30.9	26.8	24.2	21.5	20.9	9.43	0.19	1 > 2 > 3, 4, 5
Taxes and fees	28.2	24.5	24.1	22.0	19.7	4.29	0.09	1 > 2 > 3, 4, 5
Restrictions on smoking	29.9	25.5	24.6	20.7	20.7	6.62	0.14	1 > 2 > 3 > 4, 5
Part V Stages of change*								
Scale	Pre	Con	Act	Main				
Advertising and promotion	13.2	16.6	19.6	21.4		3.97	0.18	1 < 3, 4
Public education	26.3	28.8	30.3	30.8		3.05	0.14	
Laws and penalties	17.2	20.1	24.0	24.8		3.45	0.16	
Taxes and fees	10.7	19.0	21.6	22.3		6.93	0.27	1 < 2, 3, 4
Restrictions on smoking	13.3	16.8	21.6	24.3		7.12	0.28	

Note: *df = (1,172), Part I; df = (1,169), Part II; df = (2,171), Part III; df = (4,166), Part IV; df = (3,55), Part V. All values significant at $p < 0.05$.

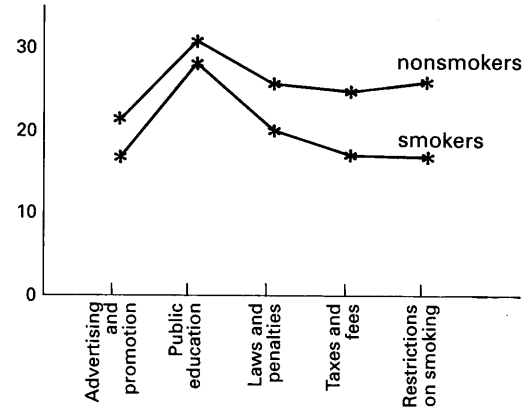

Figure 1 A comparison of smokers and nonsmokers on Smoking Policy Inventory

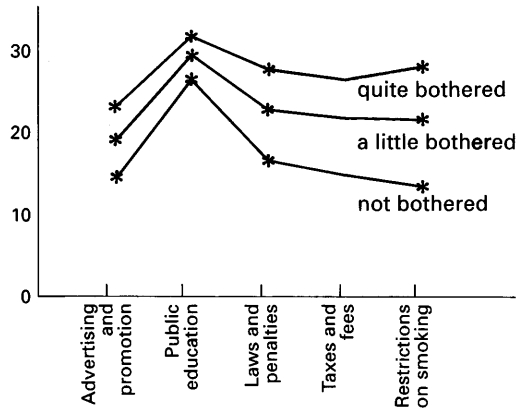

Figure 2 A comparison of sensitivity to second hand smoke and the Smoking Policy Inventory

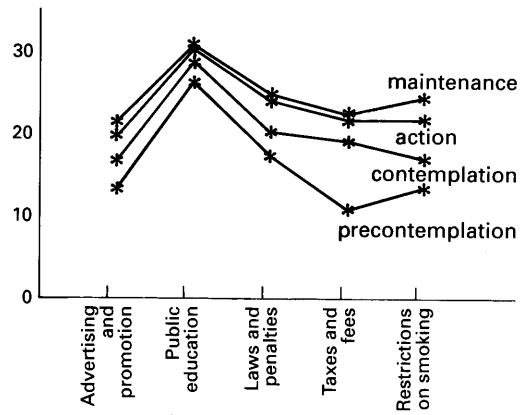

Figure 3 A comparison of stage of change status and Smoking Policy Inventory responses

nificantly higher on all five SPI scales than subjects who are "a little bothered." Subjects who are "a little bothered" by cigarette smoke showed significantly greater support for each of the five types of anti-smoking policies than subjects who are "not at all bothered." The greatest differences were on the last scale, *restrictions on smoking*, and large differences also occurred on the *laws and penalties* and *taxes and fees* scales.

Similarly, significant differences in degree of support for anti-smoking policy are associated with number of friends who smoke, but the differences were much smaller. Most of the differences were accounted for by the category of subjects who have no friends who smoke cigarettes.

Differences between subjects in different stages of change also occurred (figure 3). Support for all five categories of anti-smoking policies increased in a linear fashion, with subjects in the more advanced stages of change, such as action and maintenance, indicating more support for smoking restrictions than subjects in the earlier stages. The biggest difference was between precontemplators and the other three groups on the *taxes and fees* scale.

Study 2 Confirmation of the measurement model

METHOD

Subjects

The second sample consisted of 241 undergraduate students, 93 males and 148 females. All were solicited from psychology classes at the University of Rhode Island. The majority of the subjects were white and described themselves as middle or upper-middle class. All were at least 18 years of age.

Procedure

The refined 35-item SPI was embedded in a longer questionnaire that included demographic items and questions about subjects' experiences with smoking. Responses to the SPI items were examined using a confirmatory factor analytic technique. First, the seven items within each scale were combined to form three-item parcels. Each parcel was arbitrarily composed of the sum of two or three adjacent items within a given scale. Such composites are more reliable than single-item indicators and facilitate convergence. The resulting 15-item parcels were correlated to form a 15 x 15 matrix of SPI inter-item parcel correlations. Listwise deletion was used in creating the matrix, resulting in an n of 207. The LISREL 7 program was used to perform the confirmatory factor analyses of interest.[19] These analyses investigated five alternative models that represented competing explanations for the data structure within the SPI.

The first model, the *null model*, assumed that all observed variables were unrelated. The null model was not proposed as a serious model, but as a baseline by which to assess other models. Several fit indices rely on information provided by the null model.

The second model, the *single factor model*, tested if a single general factor accounted for all of the correlations between the observed variables. Support for this model would suggest that the SPI measured a single construct.

The third model, the *uncorrelated factors model*, consisted of five uncorrelated factors. Support for this model would suggest that the five dimensions of smoking policy previously identified (*advertising and promotion*, *public education*, *laws and penalties*, *taxes and fees*, and

restrictions on smoking) are orthogonal or independent of each other.

The fourth model, the *correlated factors model*, consisted of five correlated factors. Support for this model would suggest that individuals tend to discriminate between the five dimensions of smoking policy simultaneously, but these dimensions overlap to some extent and are not orthogonal.

The final model, the *hierarchical model*, consisted of a single second-order factor, involving each of the five first-order factors. Support for this model would suggest that a general attitude toward smoking or smoking restrictions can explain the correlations between the five individual scales.

Five different fit indices were calculated for each of the five alternative models to determine which provided the best fit to the data. These included (1) the likelihood ratio chi-square test statistic; (2) the goodness of fit index (GFI)[19]; (3) the Tucker-Lewis index (TLI)[20]; (4) the Delta2 fit index type 2[21]; and (5) the root mean square residual (RMS).[19] Because all five indices lack rigorous interpretive guidelines and no fit index is accepted as a best fit index by most researchers, it is best to compare their values across models, rather than to interpret them in an absolute sense.[22,23] Traditionally, however, values of GFI, TLI, and Delta2 above 0.80 indicate a very good fit, and values above 0.90 an excellent fit. For the RMS, values below 0.06 indicate an excellent fit. Only the TLI is reported here.

RESULTS

The five indices provided a consistent pattern of results with respect to the choice between the five models. As expected, the null model was inconsistent with the data. Neither the single factor model nor the uncorrelated factors model displayed adequate fits on any of the indices. Both the correlated factors and the hierarchical model provided very good and essentially equivalent fits across fit indices. The greater parsimony of the hierarchical model in comparison to the correlated factors model resulted in the selection of the hierarchical model as the best model to represent the data. The TLI for this model was 0.941. Figure 4 presents the hierarchical model for the SPI. The general factor was labelled *smoking policy attitude* and represents a general tendency to view all policies in a positive or negative fashion without regard to specific content. It should be noted that the size of the fit coefficients also provides a confirmation of the five-factor first-order model.

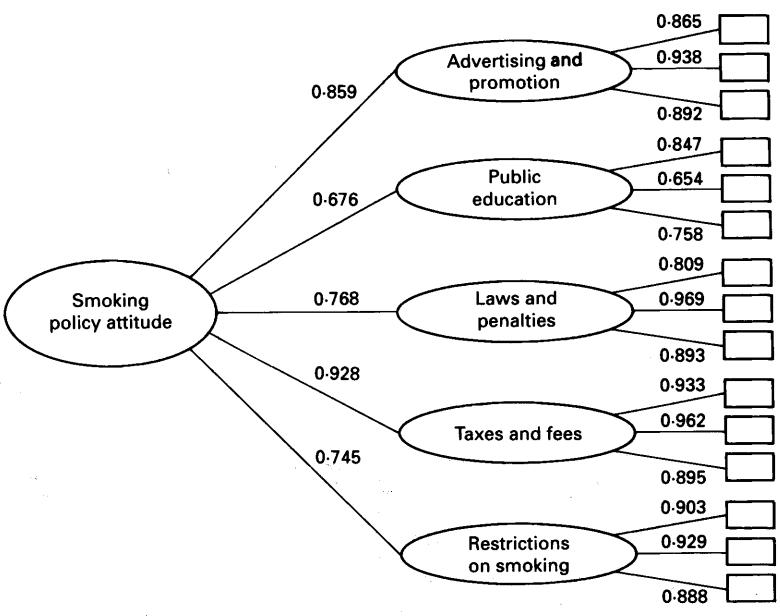

Figure 4 Standardized estimates of hierarchical model for smoking policy attitutes

Discussion

The goals of this project were to determine if a limited number of general constructs could adequately represent the smoking policy area and to develop a measure for those constructs. After generating an item pool explicitly designed to provide the broadest coverage of the area, a model involving five distinct dimensions was found to cover the area adequately. A second confirmatory study served to verify the adequacy of the model.

Item selection procedures resulted in a short 35-item inventory which measures these five dimensions of smoking policy: (1) *advertising and promotion*; (2) *public education*; (3) *laws and penalties*; (4) *taxes and fees*; and (5) *restrictions on smoking*. The seven items representing each dimension demonstrated adequate internal consistency reliability. In addition, the five scales demonstrated good external validity with respect to current smoking behaviour, intentions about future smoking behaviour, and the current smoking status of peers.

Whenever a new instrument is developed, there are two obvious questions about the internal validity that must be considered: (1) Do the items represent an adequate measure of the scales? (2) Do the scales of the instrument provide adequate coverage of the content area?

The internal consistency reliability is above 0.90 for four of the five scales. The *public education* scale has an acceptable but lower coefficient alpha of 0.83. The mean endorsement rate for the items on the *public education* scale is also much higher than for the other four scales (mean = 30.18 compared to mean = 24.58 for *laws and penalties*; see table 2). The potential range for these seven-item scales is 7.0 to 35.0, so the mean of this scale is approaching the upper limit. This may reflect the general acceptance of *public education* approaches in this sample. Alternatively, this scale may be improved by developing some alternative items to replace some of the seven items that currently make up this scale.

The second issue is whether the inventory adequately covers the whole content area, ie, are there other scales that could profitably be added to the inventory? The SPI was designed to measure the broad range of constructs that are predominant concerns in the current debate about smoking policy. Some policy

issues did not form unique factors and were not included in the 35-item version of the SPI scale. The principal components analysis did reveal a sixth weaker factor that was not included, but may merit further research. That factor contained three items that concerned the role of insurance mechanisms such as saliva testing and adverse risk rating. Since the US Surgeon General's 1979 endorsement of adverse risk rating as one potentially beneficial smoking policy mechanism,[24] only a few states have passed laws enabling this approach.[25] Our initial pool did not contain many items tapping this domain, and we are not confident that the sixth factor has been sufficiently tested to be excluded from the SPI. One item stated that insurance companies should have the right to conduct saliva testing to verify smoking status, and two items stated that smokers should pay higher insurance rates. These three items had principal components loadings of between 0.52 and 0.64 and formed a scale with a coefficient alpha = 0.79. An additional reason this sixth factor was excluded from the SPI is that it is not likely to be generally valid in different situations. For example, insurance policies and health care programmes differ greatly from state to state, from country to country, and even across occasions in the same location. A set of items that present this construct in a more general context might result in an additional scale.

The means and standard deviations presented in table 2 should be viewed as representing a comparison sample rather than test norms. The two samples were clearly not representative, being restricted with respect to both age and education level. Currently, there is a study underway which involves a random-digit-dial sample and will provide a much better set of means and standard deviations for comparison purposes.

A second concern about the use of a nonrepresentative sample is whether this in some way affects the structure of the instrument. The assumption that structure, ie, the allocation of items to scale and the relation between the scales, is factorially invariant across samples represents a basic requirement for a measurement instrument.[26,27] A recent study[28] demonstrates the high degree of factorial invariance for the SPI across six international samples. The same hierarchical model that was selected in Study 2 (see figure 1) was fit to each of the samples and the following values were obtained for the Tucker-Lewis Index (TLI) in the six samples: USA, 0.936; Australia, 0.949; The Netherlands, 0.975; South Africa, 0.918; Hong Kong, 0.909; and UK, 0.926. These results indicate an excellent fit in all six samples with values very comparable to the TLI value of 0.941 found in Study 2.

External validity for a new instrument accumulates over time as new investigations include the instrument. The initial external validity evidence provided in this paper has demonstrated that smoking status, smoking history, smoking status of friends, sensitivity to tobacco smoke, and stage of change all demonstrated clear differences in a predictable manner.

There are many additional potential applications of this SPI. A recent study used the instrument to study the differences between six countries.[28] In addition to comparisons between different geographic locations, differences across occasions can be assessed. The use of broad constructs rather than single items is particularly critical for studies involving temporal changes. Over time, the content of a single item may become dated. With a construct, other items measure the same construct so that the deletion of a single item is not critical. As with all instruments, additional items should be included in subsequent administrations to facilitate revision. Another potential use of the SPI is as an outcome measure for an intervention trial, particularly one which has policy change as a goal. It represents a good proximal outcome measure for such an intervention. The SPI could also be employed to guide intervention development, providing a means of determining which aspects of policy change would be most acceptable to members of a target group. Alternatively, the SPI could be employed to study both within-sample and between-sample differences to determine the effects of age, education level, sex, and ethnicity on changes in smoking policy. At the more general level, the instrument provides a set of items which can be common to different studies involving policy. The substitution of five broad dimensions for a large number of different items can organise the content area, simplify the analysis, and improve the reliability of the measures.

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A sample of matchbook covers from the collection of Dr John Slade, advertising pharmaceuticals and pharmacies, funeral homes and burial vaults, drug companies, hospitals, and homes for the elderly.