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## ORIGINAL RESEARCH

# Psychometric properties of the Big Five Inventory in a Chinese sample of smokers receiving cessation treatment: A validation study

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## Abstract

**Background:** Some personality traits were found to be relevant to engagement in smoking. Examination of associations between personality traits and behaviours in smoking and cessation will guide the development of effective preventive and cessation interventions. The objective of this study was to evaluate the factor structure and reliability of a Chinese version of the Big Five Inventory (BFI) for assessing the five personality dimensions of extraversion, agreeableness, conscientiousness, neuroticism and openness to experience in adults who had a smoking habit.

**Methods:** 1173 Chinese smokers who had received smoking cessation intervention at a smoking cessation health centre in Hong Kong from 21 August 2000 to January 2002 were followed-up by telephone between February and August 2008. Participants completed a questionnaire including the 44-item BFI and perceived health status. A total of 480 (41%) participants completed the survey and 439 questionnaires without missing were analysed. The factor structure of the BFI was assessed by confirmatory factor analysis, reliability by Cronbach alpha and concurrent validity by personality scores by gender and relationship with perceived health. The convergent and discriminant validity of the reduced version of BFI was compared to the original version using the multitrait-multimethod matrix approach.

**Results:** Confirmatory factor analyses revealed that the five-factor structure provided an acceptable fit after removing 15 items which did not contribute to their corresponding factors. The reduced 29-item BFI had internal reliability estimates ranged from 0.69 for agreeableness to 0.81 for neuroticism. Women scored significantly higher in neuroticism and lower in openness to experience. All the correlations of the five personality traits with perceived health were in the expected directions and statistically significant except openness to experience. The four requirements of convergent and discriminant validity of the reduced 29-item BFI were met.

**Conclusions:** These results showed that the satisfactory psychometric properties of the Chinese version of BFI with modifications; suggesting that the Chinese translation of the abbreviated 29-item BFI could be a useful and practical tool in measuring personality traits among Chinese adults had a smoking habit.

## Key words

Personality, Big five Inventory, Chinese smokers, Construct validity, Reliability, Convergent and discriminant validity, Confirmatory factor analysis

## 1 Introduction

Smoking is the biggest preventive cause of death. China has the world's largest number of smokers (57.4% in males and 2.6% in females)<sup>[1]</sup> but smoking cessation is uncommon. Hong Kong is the most westernised city of China with the lowest smoking prevalence of about 14% (24.5% male and 4.0% female)<sup>[2]</sup> and better availability of smoking cessation service, yet smoking kills about 6000 people per year, accounting for about one-fifth of all deaths<sup>[3]</sup>.

Smoking cessation should be a high priority as it will result in health gain and reduced medical burden and premature deaths due to smoking attributable diseases. Smoking cessation programs are increasingly concerned with matching interventions according to some relevant, predictive dimension prior to treatment to meet individuals' needs, such as the degree of nicotine dependency (e.g. dose of nicotine replacement therapy), and stage of readiness to change<sup>[4,5]</sup>. In the context of treatment, it is thus important to investigate how individual differences, variables or personality traits in particular are associated with quitting behaviours as individuals may vary in their successes with quitting smoking and in their responses to treatment. Understanding such relationships can then be useful for screening purposes<sup>[6]</sup>, which could inform the development of matching treatments and hence should lead to improvement in both treatment outcome and cost-effectiveness.

Research grounded in the five-factor taxonomy of personality<sup>[7]</sup> (extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience) suggests that some personality traits may be particularly relevant to engagement in smoking and hence will provide insight into smoking behavior and smoking cessation<sup>[8]</sup>. A growing literature suggests that some personality traits may be particularly relevant to engagement in smoking. Previous cross-sectional studies have indicated that smokers tend to score significantly higher in extraversion and neuroticism than non-smokers<sup>[9, 10]</sup>. Longitudinal studies also provide evidence that individual differences in extraversion and neuroticism may be important risk factors in smoking initiation<sup>[11-13]</sup>.

The five-factor model is a useful framework to measure human personality<sup>[14, 15]</sup>, organising personality into five broad dimensions: extraversion, agreeableness, conscientiousness, neuroticism and openness to experience<sup>[16]</sup>. The Big Five Inventory (BFI) was developed to provide a short, flexible and easy to understand assessment of these five dimensions for studies which focus on the five broad dimensions instead of individual facets<sup>[17]</sup>. The original BFI consists of 44 items (BFI-44), shorter than other commonly used tools measuring personality such as the 60-item form of the NEO-PI-R<sup>[18]</sup> and the IPIP Big-Five 50-item factor markers<sup>[14]</sup>. Recently, the BFI was reduced to a 10-item abbreviated version (BFI-10), with two items, one positive and one negative, per factor<sup>[19]</sup>, but the stability of this short version of the BFI might be in question as a measure of personality trait<sup>[20]</sup>. Both English and Spanish versions of the original BFI-44 were shown to have good reliability and acceptable factorial structure, and convergent and discriminant validity<sup>[16, 21, 22]</sup>. A recent cross-cultural study also showed the instrument had acceptable reliability and factor structure across 56 nations in 10 world regions<sup>[23]</sup>. The BFI-44 has been used in a wide range of studies including education, language use, and clinical research<sup>[24-27]</sup>, and also as a criterion variable for validating the IPIP Big-Five factor markers in a study conducted in China<sup>[28]</sup>. But none of these studies reported the factor structure of the BFI-44 in their samples.

It has been suggested that examining the associations between personality traits and smoking and cessation behaviours will provide insights leading to the development of effective prevention and cessation interventions<sup>[29, 30]</sup>. The BFI appears to offer substantial promise as a measure of personality traits, but most validation studies of the scale have only used undergraduate samples, which might have limited its applications to health behaviour research, in particular among smokers. There is an evident need to validate the Chinese version of the BFI-44 in the case of smokers, as China has the largest number of smokers in the world<sup>[1]</sup>.

Therefore, the purpose of this study is to examine the psychometric properties of the BFI-44 in a Chinese sample of smokers seeking cessation treatment in Hong Kong.

## 2 Methods

### 2.1 Procedures

This is a cross-sectional study which followed up 1,173 Chinese smokers who had attended a smoking cessation health centre (SCHC) in Hong Kong from 21 August 2000 to January 2002. The telephone survey was conducted from February to August 2008. An invitation letter was first mailed to all the participants with available addresses to remind them briefly about the service they had received seven years ago at the SCHC in the hospital, and explain the purpose, procedures and research team of the study. One week later, an experienced trained interviewer contacted the participants via telephone. After obtaining verbal consent, the interviewer administered the questionnaire. Any participants who could not be reached after eight calls at different times of the day were classified as lost to follow-up. We planned to contact about 150 participants per month and complete the whole follow-up survey within nine months. Three lucky draws, each with two prizes of HK\$1,000, were held every three months in the nine-month data collection period to boost the participation rate. The study was approved by the institutional review board of the university on 28 January 2008.

### 2.2 Participants

A total of 480 out of the original 1,173 smokers (41%) completed the follow-up survey, yielding a response rate of 41%; 152 refused, 522 were lost to follow-up and 19 were reported dead. Among the 480 participants, 83.8% were male, 33.5% were married and 24.4% had completed secondary school education. Their mean age was 40.6 years (SD = 12.0; range = 12 - 88 years) and mean duration of smoking was 22 years (SD = 11.7 years) at baseline, and 43.1% reported quitting for at least 30 days at the follow-up survey.

### 2.3 Measures

The Big Five Inventory consists of 44 items measuring five trait dimensions of personality - extraversion (8 items), agreeableness (9 items), conscientiousness (9 items), neuroticism (8 items) and openness to experience (9 items) - and uses a 5-point Likert scale from 1 = 'strongly disagree' to 5 = 'strongly agree'. The instrument was first translated into Chinese by an experienced researcher with a first degree in translation and then checked by the research team, who were fluent in both English and Chinese. Care was taken to ensure each item translated retained a meaning as close as possible to the original version by means of a back translation process. One item was used to measure perceived health status in the past three months using a 5-point Likert scale ranged from 1 = 'very poor' to 5 = 'very good'.

### 2.4 Data analysis

Confirmatory factor analysis (CFA) was used to assess the factor structure of the BFI among the 439 participants who completed all 44 items of the BFI. A five-factor model with items corresponding to each of the five trait dimensions as proposed by the instrument developers was fitted to the covariance matrix of the BFI items. According to the recommendations for personality data<sup>[31, 32]</sup>, we evaluated the model goodness-of-fit using (1) robust root mean square error of approximation (R-RMSEA) with a 90% confidence interval for non-normal data, (2) standardised root mean squared residuals (SRMR) and (3) standardised factor loadings. A good fit to the data was indicated by SRMR < 0.08, R-RMSEA < 0.06<sup>[33]</sup> and standardised factor loadings  $\geq 0.4$ <sup>[34]</sup>. If the model did not fit the data well, it was re-specified by deleting items which did not contribute to their corresponding component, i.e. the items with standardised factor loadings < 0.4. The re-specified model was then assessed for goodness-of-fit with the data. If the re-specified model still did not fit the data well, the reduction procedure was repeated and the re-specified model assessed again. Model chi-square test statistics and associated degrees of freedom, and a robust comparative fit index were also reported for completeness, although they were not used for model evaluation. Once an acceptable model had been achieved, the reliability of each of the five personality trait dimensions was assessed by Cronbach's alpha and concurrent validity by correlation with current perceived health status. For each of the five personality dimensions, the mean score was computed by averaging the corresponding items in that dimension. Gender differences in each of the five personality traits were compared using

Mann-Whitney tests. Moreover, the convergent and discriminant validity of the reduced BFI obtained in the above CFA procedure were compared with the original BFI-44 by computing the multitrait-multimethod matrix<sup>[35]</sup>. All CFAs were performed using EQS 6.0<sup>[36]</sup> with the robust correction to maximum likelihood estimation procedure as the data were found to be non-normal (normalised estimate = 48.14)<sup>[37]</sup>. Cronbach's alpha, Pearson's correlation and Mann-Whitney tests were computed by SPSS18.0. All statistical tests were two-tailed, and results were considered significant at  $p < 0.05$ .

### 3 Results

#### 3.1 Confirmatory factor analysis and reliability

The CFA results revealed that the 5-factor model (Model 1) provided a poor fit with the data of the full 44-item BFI (see Table 1). Inspection of standardised factor loadings of items in Model 1 (see Table 2) revealed that 13 out of 44 (two for extraversion, three for agreeableness, three for conscientiousness, one for neuroticism and four for openness to experience) were  $< 0.4$ , and these were therefore deleted from the model. The re-specified five-factor model with the remaining 31 items of the BFI (Model 2) provided an acceptable fit with the data, but standardised factor loadings of two items (one for agreeableness and one for conscientiousness) were still  $< 0.4$ . The reduction procedure was thus repeated after deleting these two items and formed Model 3 with the remaining 29, which gave an acceptable fit with the data, all standardised factor loadings being  $> 0.4$ . Except for a large positive correlation between agreeableness and conscientiousness (0.81), and a non-significant negative correlation between neuroticism and openness to experience (-0.06), the estimated factor correlations between the five personality traits in Model 3 were moderate in magnitude, suggesting the five personality traits were distinct and correlated factors in general. The reliability of the five personality dimensions of the reduced 29-item BFI was satisfactory, with the Cronbach's alpha values of the five dimensions ranging from 0.69 to 0.81<sup>[38]</sup>.

**Table 1.** Results of confirmatory factor analysis of model testing (n = 439)

	R- $\chi^2$	df	R-CFI	SRMR	R-RMSEA
Model 1 (44-item)	2311.7	892	0.642	0.094	0.062 (0.059 – 0.065)
Model 2 (31-item)	1011.7	424	0.800	0.080	0.057 (0.052 – 0.062)
Model 3 (29-item)	813.8	367	0.835	0.075	0.054 (0.049 – 0.058)

Note. R- $\chi^2$  = Robust model chi-square statistic; df = degree of freedom; R-CFI = Robust Comparative Fit Index; SRMR = standardised root mean squared residuals; R-RMSEA = robust root mean square error of approximation.

**Table 2.** Standardised factor loadings for alternative models of the BFI (n = 439)

	Model 1 (44 items)	Model 2 (31 items)	Model 3 (29 items)
<b>Extraversion</b>			
1. Is talkative	0.652	0.658	0.658
6. Is reserved (-)	0.022	---	---
11. Is full of energy	0.514	0.515	0.518
16. Generates a lot of enthusiasm	0.495	0.497	0.493
21. Tends to be quiet (-)	-0.504	-0.504	-0.501
26. Has an assertive personality	-0.043	---	---
31. Is sometimes shy, inhibited (-)	-0.438	-0.436	-0.436
36. Is outgoing, sociable	0.758	0.759	0.760
Cronbach's alpha			0.72

(Table 2 continued on page 5)

**Table 2.** (Continued.)

	<b>Model 1 (44 items)</b>	<b>Model 2 (31 items)</b>	<b>Model 3 (29 items)</b>	
<b>Agreeableness</b>				
2. Tends to find fault with others (-)	-0.179	---	---	
7. Is helpful and unselfish with others	0.520	0.556	0.589	
12. Starts quarrels with others (-)	-0.235	---	---	
17. Has a forgiving nature	0.538	0.528	0.552	
22. Is generally trusting	0.596	0.618	0.619	
27. Can be cold and aloof (-)	-0.462	-0.390	---	
32. Is considerate and kind to almost everyone	0.566	0.575	0.583	
37. Is sometimes rude to others (-)	-0.347	---	---	
42. Likes to cooperate with others	0.491	0.517	0.511	
Cronbach's alpha			0.69	
<b>Conscientiousness</b>				
3. Does a thorough job	0.465	0.494	0.487	
8. Can be somewhat careless (-)	-0.274	---	---	
13. Is a reliable worker	0.497	0.571	0.576	
18. Tends to be disorganised (-)	-0.372	---	---	
23. Tends to be lazy (-)	-0.478	-0.386	---	
28. Perseveres until the task is finished	0.601	0.608	0.607	
33. Does things efficiently	0.608	0.608	0.609	
38. Makes plans and follows through with them	0.616	0.604	0.608	
43. Is easily distracted (-)	-0.378	---	---	
Cronbach's alpha			0.71	
<b>Neuroticism</b>				
4. Is depressed, blue	0.627	0.624	0.623	
9. Is relaxed, handles stress well (-)	-0.463	-0.434	-0.432	
14. Can be tense	0.713	0.736	0.738	
19. Worries a lot	0.684	0.695	0.695	
24. Is emotionally stable, not easily upset (-)	-0.580	-0.555	-0.553	
29. Can be moody	0.605	0.600	0.597	
34. Remains calm in tense situations (-)	-0.340	---	---	
39. Gets nervous easily	0.718	0.733	0.735	
Cronbach's alpha			0.81	
<b>Openness to experience</b>				
5. Is original, comes up with new ideas	0.694	0.677	0.679	
10. Is curious about many different things	0.421	0.440	0.442	
15. Is ingenious, a deep thinker	0.527	0.553	0.552	
20. Has an active imagination	0.653	0.659	0.659	
25. Is inventive	0.781	0.775	0.774	
30. Values artistic, aesthetic experiences	0.399	---	---	
35. Prefers work that is routine (-)	-0.060	---	---	
40. Likes to reflect, play with ideas	0.505	0.531	0.530	
41. Has few artistic interests (-)	-0.171	---	---	
44. Is sophisticated in art, music or literature	0.285	---	---	
Cronbach's alpha			0.77	
<b>Factor correlations in Model 3</b>				
	<b>A</b>	<b>C</b>	<b>N</b>	<b>O</b>
E	0.557	0.501	-0.396	0.586
A		0.812	-0.234	0.446
C			-0.288	0.542
N				-0.062

Note: (-) = negatively worded item; Bold = standardised factor loading < 0.4; E = Extraversion; A = Agreeableness; C = Conscientiousness; N = Neuroticism; O = Openness to experience

### 3.2 Personality scores by gender and relationship with perceived health

Some gender differences were observed in the mean scores of the personality traits, in particular, women displayed significantly higher scores on neuroticism and lower scores on openness to experience than men, while there was no significant difference in the mean scores for extraversion, agreeableness and conscientiousness (see Table 3). Correlations between the reduced BFI-29 and perceived health status were in the expected directions: neuroticism was negatively and the remaining four were positively correlated with perceived health status. Although small in magnitude, all the correlations were statistically significant except that for openness to experience.

**Table 3.** Mean scores by sex and correlations with perceived health status (n = 439)

Personality trait	Total (n=439)		Men (n=368)		Women (n=71)		Perceived health status	
	M	SD	M	SD	M	SD	p-value	Correlation
Extraversion	3.35	0.61	3.36	0.62	3.33	0.61	0.73	0.19*
Agreeableness	3.37	0.52	3.68	0.50	3.60	0.60	0.24	0.11*
Conscientiousness	3.74	0.56	3.75	0.57	3.65	0.48	0.16	0.13**
Neuroticism	2.71	0.68	2.68	0.67	2.87	0.72	0.025	-0.26**
Openness to experience	3.19	0.65	3.22	0.66	3.01	0.56	0.012	0.07

\*p<0.05, \*\*p<0.01

### 3.3 Convergent and discriminant validity of the reduced BFI-29

Examining the multitrait-multimethod matrix of the scores based on the original BFI-44 and the reduced BFI-29 revealed that all the four requirements for convergent and discriminant validity were met: (1) the validity diagonal values of the five traits between the two methods are sufficiently large (> 0.82) and significantly different from zero, (2) all the validity diagonal values are higher than the corresponding values in the heterotrait-heteromethod triangles (< 0.41), (3) all the validity diagonal values are higher than the corresponding values in the heterotrait-monomethod triangles (< 0.57), and a similar pattern of trait interrelationship was observed in all of the heterotrait triangles of both the monomethod and heteromethod blocks (see Table 4) [35]. The results hence suggest that the reduced BFI-29 shows a good evident of convergent and discriminant validity as compared with the original BFI-44.

**Table 4.** The multitrait-multimethod matrix of the original BFI-44 and the reduced BFI-29 (n = 439)

	BFI-44					BFI-29					
	A <sub>1</sub>	B <sub>1</sub>	C <sub>1</sub>	D <sub>1</sub>	E <sub>1</sub>	A <sub>2</sub>	B <sub>2</sub>	C <sub>2</sub>	D <sub>2</sub>	E <sub>2</sub>	
<b>BFI-44</b>											
Extraversion	A <sub>1</sub>	(.61)									
Agreeableness	B <sub>1</sub>	.34	(.57)								
Conscientiousness	C <sub>1</sub>	.28	.47	(.33)							
Neuroticism	D <sub>1</sub>	-.33	-.39	-.45	(.80)						
Openness to experience	E <sub>1</sub>	.31	.10	.19	-.07	(.72)					
<b>BFI-29</b>											
Extraversion	A <sub>2</sub>	.95	.41	.35	-.40	.35	(.72)				
Agreeableness	B <sub>2</sub>	.37	.82	.43	-.28	.20	.41	(.69)			
Conscientiousness	C <sub>2</sub>	.32	.47	.82	-.32	.25	.37	.56	(.71)		
Neuroticism	D <sub>2</sub>	-.30	-.36	-.39	.97	-.05	-.37	-.23	-.26	(.81)	
Openness to experience	E <sub>2</sub>	.40	.19	.35	-.13	.87	.45	.34	.43	-.08	(.77)

## 4 Discussion

The purpose of the current study was to examine further the factorial validity of the BFI-44 as reported in previous research with university students<sup>[21, 22]</sup>, but using a Chinese adult population with a smoking habit. The results show that the psychometric properties of the 29-item abbreviated version of the BFI were generally supported. Confirmatory factor

analysis revealed an acceptable fit for the 5-factor model with the Chinese version of the BFI as postulated by its developers, with some modifications. Each of the five dimensions in the 29-item abbreviated version of the BFI also showed a high reliability and significant correlations with perceived health status.

With an exploratory process using confirmatory factor analysis, we found that 29 out of 44 intended items (65.9%) showed better psychometric properties in respect to their corresponding personality trait scale so that the 15 less satisfactory items (factor loadings < 0.4) were removed. Given the concern about the reluctance of participants to complete a long questionnaire, the testing process is very useful in producing an instrument which is as short as possible, while at the same time including all relevant dimensions and providing a reliable measure of them.

On the other hand, twelve out of these 15 removed items were negatively worded (one out of two in extraversion, all four in agreeableness, all four in conscientiousness, the single one in neuroticism and two out of four in openness to experience), suggesting the participants might have interpreted the positively and negatively worded items differently in the BFI-44. Inclusion of both item types may reduce response bias but it also introduces systematic bias in the form of undesirable components and complicates the factor structure<sup>[39]</sup>. It is possible that the BFI-44, similar to other instruments such as the Rosenberg Self-Esteem Scale<sup>[40]</sup> and General Health Questionnaire<sup>[41]</sup>, also suffers from the effects associated with negatively worded items. Further studies are warranted to examine whether this is a culture-specific-issue or an inherent problem of the BFI-44.

There were significant correlations and in the expected directions between most dimensions. The correlations between extraversion, agreeableness, conscientiousness and openness to experience were quite strong, exceeding values of 0.4. The correlation of neuroticism and openness to experience, on the other hand, was insignificant, which was also reported in the study by Musek (2007)<sup>[42]</sup>. Nevertheless, these results further confirmed that the five personality dimensions were correlated as expected in the sample of Chinese adults had a smoking habit.

Consistent with a previous study by Löckenhoff et al<sup>[43]</sup>, the five personality traits in the BFI correlated with perceived health status in our sample. In particular, neuroticism had the strongest negative association, then followed by extraversion and conscientious with positive association. Our results also support the finding of Löckenhoff et al's study of no association between perceived health status and openness to experience, providing some evidence for concurrent validity of the abbreviated version of the BFI in our sample.

In this study, we also found that women reported a significantly higher mean score on neuroticism, in line with studies showing that women smoked more for tension reduction/relaxation compared to men<sup>[44]</sup>. The findings on the significantly lower mean score in openness to experience among our female participants was somewhat surprising. Since our sample consisted of participants who had proactively sought smoking cessation counselling, it is possible that smoking women who were willing to try new things or were open to new experience were more likely to look for and receive counselling. The results have thus generated a new research hypothesis in linking personality and motivation for quitting.

## 5 Limitations

There are several limitations of the study. First, the present validation study of the BFI was based on a seven-year follow-up of a cohort of Chinese smokers who had received smoking cessation treatment, and the sample in the current study therefore consisted of both current and ex-smokers and different follow-up time of participants, which may limit the generalisability of our results to the Chinese smoking population as a whole. Since personality traits are believed to be very stable over time, especially among adults<sup>[45]</sup>, the current findings should be generalisable given the large smoking population and that more smoking cessation services are expected to be available in China<sup>[46]</sup>. Second, the use of a single-item measure of perceived health status in the study may include some measurement errors leading to an underestimation of the correlations with other variables<sup>[47]</sup>, thus providing an explanation for its small magnitude in the



observed correlations with the personality trait scores in the study. Third, reliance on self-reported data may introduce bias due to social desirability or different interpretations of item content (wording effects), especially in the case of the current study where the instrument was administered by an interviewer over the telephone.

## 6 Conclusions

In conclusion, the results of the study with a Chinese smoking sample gave preliminary evidence of a five-factor structure and good reliability of the five dimensions in the BFI after deletion of 15 items. The abbreviated 29-item version of the BFI appears to be a practical instrument for measuring personality traits in a Chinese smoking population. This offers health care professionals who involved in providing smoking cessation interventions to Chinese smokers with a practical and usable instrument. It is recommended that more psychometric studies on the abbreviated 29-item BFI using different languages and data of both self- and peer-ratings to assess inter-rater reliability are needed.

## Competing interests

The authors declare that they have no competing interests.

## Authors' contributions

DL participated in the design of the study, performed the statistical analysis, interpreted the results and drafted the manuscript. EW participated in data collection and critically revised the manuscript. THL participated in the design of the study, and helped to draft and revise the manuscript. SC participated in both design and coordination, and helped to revise the manuscript. All authors read and approved the final manuscript.

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