ORIGINAL RESEARCH

Assessing the Psychometric Properties of the Chinese Version of Ten-Item Personality Inventory (TIPI) Among Medical College Students

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Objective: The Ten-Item Personality Inventory (TIPI) was designed as a brief instrument of the Big Five personality traits. This study aimed to explore the internal consistency and structural validity of the Chinese version of TIPI (TIPI-C) in medical college students.
Methods: A cross-sectional study was conducted in 11 provinces of China. Spearman–Brown coefficient, standardized Cronbach's α coefficient, and Cronbach's α coefficient were applied to estimate the internal consistency. Spearman–Brown coefficient was applied to estimate split-half reliability. Principal components analysis (PCA) and confirmatory factor analysis (CFA) were used to identify the structural validity.
Results: A total of 2223 medical college students recruited from different regions of China were included. The Spearman–Brown coefficients of TIPI-C ranged from 0.129 to 0.786 and the Cronbach's α coefficients ranged from 0.119 to 0.785. The split-half reliability of the Spearman–Brown coefficient was 0.508. The latent structure of Extraversion, Emotional Stability, and Conscientiousness complied with the intended structure, and the internal consistency coefficients of these three traits were supported. However, the internal consistency coefficients of Agreeableness and Openness were low and the structural validity was not supported.
Conclusion: TIPI-C primarily stands out as a feasible instrument for brief measurements of the Extraversion, Emotional Stability, and Conscientiousness domains. Further research is required to evaluate the concurrent validity and the test–retest reliability of TIPI-C in different populations and potentially modify the instrument to be more suitable for the Chinese population.
Keywords: Big Five personality, Ten-Item Personality Inventory, TIPI, reliability, validity, China

Introduction

Personality refers to psychological qualities that contribute to an individual's enduring and distinctive patterns of feeling, thinking and behavior.[1] Personality traits are among the most basic variables in personality description.[2] The five-factor model (FFM) is currently the predominant model in personality psychology,[3] which consists of five higher-order traits or dimensions of personality, including Emotional Stability (to be calm, relaxed) or Neuroticism, Extraversion (to be sociable, active), Openness (to be curious, creative), Agreeableness (to be softhearted, trusting) and Conscientiousness (to be organized, reliable).[4]

Many instruments have been developed and validated to measure personality traits, of which the 240-item NEO Personality Inventory Revised (NEO-PI-R) was the most comprehensive instrument.[4] However, due to a large number of items, it takes a long time to accurately measure personality.[5] To reduce response burden, several shorter instruments have been developed, such as the 44-item Big-Five Inventory (BFI), 60-item NEO Five-Factor Inventory (NEO-FFI) and 100 Trait Descriptive Adjectives (TDA).[6,7] It has been reported that it took about 5, 15 and 15 minutes to complete the BFI, NEO-FFI, and TDA, respectively.[7] These instruments are still considered to be too long to use in large-scale population surveys.[3,8]

The Ten-Item Personality Inventory (TIPI) was developed as an extremely brief instrument of the Big-Five personality that can be self-completed within one minute.[5] With a total of 10 items, the TIPI uses two-item to describe each Big-Five personality dimension. It has been translated into at least 24 languages,[9] and the psychometric properties have been validated in German,[3] Portugal,[10] Japan.[11] To the best of our knowledge, there are three Chinese versions of the TIPI (hereafter "TIPI-C") in Mainland China.[9,12,13] Two versions of TIPI-C, which were developed by Jackson Lu and Minyan Huang respectively, can be obtained on the official website of TIPI.[9,12] The third Chinese version of TIPI-C was translated by Jinde Li, and its psychometric properties have been studied based on 1130 middle school students and undergraduates.[13] The study concluded that there were sufficient psychometric properties of the TIPI-C concerning the internal consistency, test-retest reliability, construct validity, and concurrent validity.[13] This is by far the only version to assess the psychometric properties of TIPI-C; however, the study sample was recruited from one particular region. Furthermore, Lulu Li's study found the test-retest reliability and construct validity of TIPI-C (Jinde Li version) were sufficient among Chinese breast cancer patients, but it has been proposed that the internal consistency was not optimistic.[14] Therefore, it is important to understand the psychometric properties of the TIPI-C instrument.

Medical college students are the major human resources of the healthcare system and will play an important role in medical and healthcare services in the future.[15] The previous studies have confirmed that personality plays a significant role in medical education academic performances,[16–18] and it also has been shown to forecast how medical students are likely to perform in the medical profession.[19,20] Medical students with Extraversion and Openness were found to be increasingly strong predictors of academic performance over time.[17] Furthermore, it has been found that medical students with high Agreeableness were good at communication and collaboration skills, and they also had a more positive attitude to avoid medical errors in the future.[21,22] As a brief personality instrument, the TIPI could be a useful measurement tool, particularly when measuring personality is only part of the whole survey or the survey time is limited.[5] Thus, it is of great significance to adopt a brief validated instrument to measure the personality traits, and it will be better to select the medical students during admissions and personnel decisions in densely populated China.

This study aimed to evaluate the internal consistency and structural validity of TIPI-C (Minyan Huang version) based on a large-scale medical college student sample in China and explore the personality differences of medical college students.

Materials and Methods
Design, Participants and Procedures

The TIPI-C was embedded in a series of surveys to investigate the job preferences of medical college students. The recruitment processes varied by each major of the students and all details have been reported in previous publications for students majoring in medicine, health management, nursing, and pharmacy.[23–26] In brief, a multistage sampling design was used. First, according to the geographical location and the economic development level, 11 provinces were selected which were located in the east (Beijing, Hebei, Shandong, Jiangsu), middle (Henan, Shanxi), west (Shaanxi, Ningxia, Gansu), and northeast of China (Heilongjiang, Liaoning) (Figure S1). Next, according to the population size of each province and the number of majors in different medical colleges, 16 universities were chosen. Finally, one to three classes in each university were randomly selected depending on the number of students in each class.

The investigator explained the meaning of the face-to-face anonymous survey and the requirements to fill in the questionnaire. All participants provided informed verbal consent before completing the questionnaire. A detailed explanatory statement was given to respondents describing the study, which highlighted that their participation was voluntary and no identifiable personal data would be collected. As explained above, respondents were fully aware of the aim and task of the study before they provided verbal consent to participate in this anonymous study. Students who provided informed consent completed the questionnaire by themselves. When the participants did not understand the questionnaire, the investigator would give an explanation. Respondents could withdraw at any time if they did not want to participate in the survey. Finally, all the completed questionnaires were returned directly to the investigator. The study has been approved by the Ethics Review Board of the School of Preventive Medicine, Shandong University (Reference No. 20170301).

Instruments

The TIPI is comprised of 10 items, each scored from 1 (strongly disagree) to 7 (strongly agree). Each dimension of the Big Five-factor (E-Extraversion, A-Agreeableness, C-Conscientiousness, ES-Emotional Stability and O-Openness) is represented by two items, and when calculating the dimension score (ie, the mean score of two items), one item should be reverse-coded (for example, on the 7-point scale, a score of "7" is transformed into a "1", and vice versa). The reverse-scored items are 2, 4, 6, 8, 10.[9] The higher score indicates a higher level of the trait.[8,27] The questionnaire also contained questions related to participants' sociodemographic characteristics, including age, gender, birthplace, whether the only child, major, annual family income, and monthly consumption level.

Data Analysis

Descriptive analysis was applied to describe participants' sociodemographic characteristics and TIPI-C scores, including presenting mean (standard deviation, SD) or median for continuous variables and frequency (%) for categorical variables. The normality of TIPI-C scores was tested by the Shapiro–Wilk W-test and normal Q-Q plots. The one-way ANOVA and Kruskal–Wallis H were used to examine the differences among the TIPI-C scores.

Floor and ceiling effects can be used as a proxy of sensitivity concerning how well an instrument can detect changes within cross-sectional studies.[28] Floor or ceiling effects were considered to be presented if more than 15% of the responders achieved the lowest or highest possible score, respectively.[29,30] We calculated the percentages of participants with the highest or lowest possible scores of the five factors. Spearman–Brown coefficient, standardized Cronbach's α coefficient, and Cronbach's α coefficient were applied to estimate the internal consistency.[31] Spearman–Brown coefficient was applied to estimate split-half reliability. A Cronbach's α coefficient and Spearman–Brown coefficient of 0.7 or above were considered appropriate.[32] Spearman correlation coefficients (r) were estimated for inter-item correlation, including correlation between 10 items. The correlation (r)>0.7 was considered strong; moderate, $0.3<r<0.7$; and weak, $r<0.3$.[33]

Confirmatory factor analysis (CFA) and principal components analysis (PCA) were used to identify the structural validity. The total sample was randomly divided into a calibration sample used for PCA (N=889, 40% of the total sample) and a validation sample used for CFA (N=1334, 60% of the total sample).[10,34] CFA was conducted to test the five-factor model of TIPI-C, and the maximum likelihood method was used to estimate parameters. Multiple indices were used to assess the model fit, including Chi-square divided by degree of freedom (χ^2/df), the root of mean square residual (RMR), root-mean-square error of approximation (RMSEA), the goodness of fit index (GFI), normed fit index (NFI), Tucker-Lewis index (TLI) and comparative fit index (CFI). The cut-off values for acceptable model fit used in this study were above $\chi^2/df<3$, RMR≤0.01, RMSEA<0.08, GFI>0.90, NFI>0.90, TLI>0.90, CFI>0.90.[35]

The Bartlett's test of sphericity (p<0.05) and a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy reaching ≥0.50 will be considered appropriate to conduct PCA.[36,37] The extraction of factors was conducted through the principal components analysis (PCA) and Varimax rotation.[10,38,39] The eigenvalues of each factor were set as greater than 1, and loadings smaller than 0.40 were suppressed.[40,41]

Firstly, CFA was conducted to test the five-factor model of TIPI-C, and the number of factors to be extracted was determined according to the five-factor model of the TIPI (ie, a 5 factor was specified) for PCA. Secondly, in the case that the five-factor model has a poor model fit, we decided the number of factors to be extracted based on the eigenvalues greater than 1. Scree plot was used to support the number of factors been selected.[42]

All statistical tests were two-sided and p values <0.05 were considered to be statistically significant. Data were double-entered into EpiData 3.1. Statistical analysis was performed using SPSS 26.0 and AMOS 21.0.

Results

Participants Characteristics

A total of 2431 students were recruited for the survey, and 208 participants were excluded due to incomplete answers. The final sample consists of 2223 participants (91.4%) (see Table 1 for more details). The mean (SD) age of participants was 22.5 (2.2) years; most (74.1%) of them were females and more than half of (56.2%) participants were born in rural China.

Table 1 Demographic Characteristics of Medical College Students

Characteristics	Number (%)
Age (year), Mean ± SD	22.5 ± 2.2
Gender*	
Male	576 (25.9)
Female	1644 (74.1)
Birthplace	
Urban	541 (24.3)
County	433 (19.5)
Rural	1249 (56.2)
Only child	
Yes	798 (35.9)
No	1425 (64.1)
Major	
Medicine	489 (22.0)
Pharmacy	581 (26.1)
Nursing	507 (22.8)
Health care management	646 (29.1)
Annual family income (Chinese Yuan, CNY)	
<30,000 CNY	560 (25.2)
30,000–50,000 CNY	682 (30.7)
50,000–70,000 CNY	381 (17.1)
70,000–90,000 CNY	231 (10.4)
> 90,000 CNY	369 (16.6)
Monthly consumption level (Chinese Yuan, CNY)	
< 800 CNY	449 (20.2)
800–1500 CNY	1412 (63.5)
1500–2500 CNY	308 (13.9)
> 2500 CNY	54 (2.4)

Note: *Missing value (n=3).
Abbreviation: SD, standard deviation.

Descriptive Statistics and Sensitivity

The descriptive statistics and sensitivity of the TIPI-C subscales were presented in Table 2. The highest mean scores were found for Conscientiousness 5.31 (SD=1.19), followed by Agreeableness 5.07 (SD=1.06), Openness 4.74 (SD=1.11), Emotional Stability 4.55 (SD=1.31), and Extraversion 4.45 (SD=1.60). No floor or ceiling effect was found (Table 2). Except for the Openness observed range from 1.5 to 7, the other four factors range from 1 to 7.

Internal Consistency and Split-Half Reliability

As can be seen in Table 3, internal consistency was the highest for the Extraversion (Spearman-Brown=0.786; standardized α=0.786; α=0.785), followed by Emotional Stability (Spearman-Brown=0.566; standardized α=0.566;

Table 2 Descriptive Statistics and Sensitivity of the TIPI-C (N=2223)

Five-Factor	Theoretical Range	Observed Range	Mean (SD)	Median	Ceiling Effect N (%)	Floor Effect N (%)
E	1–7	1–7	4.45 (1.60)	4.50	27 (1.2)	155 (7.0)
A	1–7	1–7	5.07 (1.06)	5.00	3 (0.1)	115 (5.2)
C	1–7	1–7	5.31 (1.19)	5.50	8 (0.4)	196 (8.8)
ES	1–7	1–7	4.55 (1.31)	4.50	13 (0.6)	68 (3.1)
O	1–7	1.5–7	4.74 (1.11)	4.50	9 (0.4)	77 (3.5)

Notes: Ceiling effect: 15% of respondents scored the highest scores 7. Floor effect: 15% of respondents scored the lowest scores 1.
Abbreviations: E, Extraversion; A, Agreeableness; C, Conscientiousness; ES, Emotional Stability; O, Openness. SD, standard deviation.

Table 3 Internal Consistency of the TIPI-C

Five-Factor	Spearman–Brown Coefficients	Standardized Cronbach's α	TIPI-C Cronbach's α	TIPI Original Version Cronbach's α[a]
E	0.786	0.786	0.785	0.680
A	0.129	0.129	0.119	0.400
C	0.514	0.514	0.513	0.500
ES	0.566	0.566	0.563	0.730
O	0.319	0.319	0.315	0.450

Notes: [a]Reference [5] Gosling et al (2003).
Abbreviations: E, Extraversion; A, Agreeableness; C, Conscientiousness; ES, Emotional Stability; O, Openness.

α=0.563), Conscientiousness (Spearman-Brown=0.514; standardized α=0.514; α=0.513), Openness (Spearman-Brown=0.319; standardized α=0.319; α=0.315), and the lowest was Agreeableness (Spearman-Brown=0.129; standardized α=0.129; α=0.119). The TIPI-C 10-item can be divided into two groups according to whether they need to be reverse-coded, and the split-half reliability of the Spearman–Brown coefficient was 0.508.

Spearman Correlation Between 10 Items and Five-Factor

Table 4 showed the correlation coefficients between 10 items and five-factor. The strengths of correlations between positively and negatively items for the Extraversion ($r=-0.656$), Conscientiousness ($r=-0.360$) and Emotional Stability ($r=-0.398$) were higher than correlations with items from other traits, and the three correlation coefficients were moderate. However, the strengths of correlations between positively and negatively items for the Agreeableness ($r=-0.077$) and Openness ($r=-0.217$) were lower than correlations with items from other traits.

Structural Validity

The confirmatory factor analysis (CFA) was conducted to test the five-factor structure. The results ($\chi^2/df=22.449$ RMR=0.242, RMSEA=0.127, GFI=0.915, NFI=0.747, TLI=0.573, CFI=0.753) showed that the five-factor model had a poor fit, although the GFI of 0.915 was within the acceptable range.

The results from PCA showed that the KMO was 0.644, Bartlett's test of sphericity coefficient was 1491.79 ($p \leq 0.001$), and there were confirmed that the data were appropriate to proceed to factor analysis.[36,37]

Initially, according to the five-factor model of the TIPI, we specified five factors to be extracted. As can be seen in Table S1, the items for Extraversion, Emotional Stability, Conscientiousness and Openness were clustered in factors 1, 2, 3 and 4, respectively. Extraversion, Emotional Stability and Conscientiousness were three factors with an eigenvalue greater than 1, but the eigenvalues of Openness (0.926) were less than 1. The factor structure for Extraversion, Emotional Stability and Conscientiousness complied with the intended structure. The scree plot was also graphically displayed to support the extraction of three factors (Figure S2). The absolute values of the factor loading in these three factors ranged from 0.680 to 0.903, which explained 22.2%, 20.5%, and 11.6% of the total variance, respectively. Results revealed that the five factors accounted for 71.7% of the total variance. The CFA results and the PCA based on the five-factor structure were poor.

Next, we extracted factors based on the rule of eigenvalues greater than 1 and a three-factor structure was identified. This structure has shown the loadings of 4 items (1, 6, 2, and 10) on factor 1, 4 items (7, 3, 8, and 5) on factor 2, and 4 items (2, 8, 4, and 9) on factor 3, item 2 and item 8 loaded in the 2 factors (Table 5).

TIPI-C Scores Among Different Participants' Sociodemographic Characteristics

Table 6 presented the TIPI-C scores among different participants' sociodemographic characteristics. Females had higher scores than males on Agreeableness (p<0.05), but had lower scores on Emotional Stability (p<0.05). The only child had lower scores on Agreeableness and Conscientiousness than the child with siblings (p<0.05). Students from different

Table 4 Spearman Correlation Between 10 Items and Five-Factor (N=2223)

	E	A	C	ES	O	1	6	2	7	3	8	4	9	5	10
E	1														
A	−0.164**	1													
C	0.082**	0.203**	1												
ES	−0.035	0.273**	0.339**	1											
O	0.271**	−0.085**	0.223**	0.101**	1										
1 (E)	**0.895****	−0.131**	0.139**	0.012	0.291**	1									
6 (E-r)	**−0.920****	0.176**	−0.017	0.069**	−0.211**	**−0.656****	1								
2 (A-r)	0.257**	**−0.869****	−0.064**	−0.225**	0.191**	0.255**	−0.218**	1							
7 (A)	0.105**	**0.513****	0.302**	0.173**	0.161**	0.154**	−0.037	***−0.077****	1						
3 (C)	0.051*	0.146**	**0.778****	0.253**	0.149**	0.120**	0.020	0.001	0.293**	1					
8 (C-r)	−0.087**	−0.192**	**−0.846****	−0.300**	−0.223**	−0.115**	0.049*	0.105**	−0.229**	**−0.360****	1				
4 (ES-r)	−0.084**	−0.202**	−0.260**	**−0.862****	−0.132**	−0.082**	0.074**	0.202**	−0.092**	−0.146**	0.272**	1			
9 (ES)	−0.168**	0.265**	0.320**	**0.794****	0.030	−0.082**	0.215**	−0.184**	0.213**	0.294**	−0.240**	**−0.398****	1		
5 (O)	0.166**	−0.063**	0.161**	0.071**	**0.712****	0.211**	−0.098**	0.169**	0.163**	0.168**	−0.115**	−0.036	0.086**	1	
10 (O-r)	−0.253**	0.070**	−0.180**	−0.098**	**−0.817****	−0.248**	0.224**	−0.124**	−0.098**	−0.080**	0.218**	0.174**	0.019	**−0.217****	1

Notes: **p<0.01; *p<0.05. r-denotes reverse-scored items. Correlations between positively and negatively keyed TIPI items for the same dimension are shown in bold typeface, the item on Agreeableness and Openness lower than other traits are shown in bold italic type.
Abbreviations: E, Extraversion; A, Agreeableness; C, Conscientiousness; ES, Emotional Stability; O, Openness.

Table 5 Principal Component Analysis for the TIPI-C Three-Factor Model (N=889)

Item Content	Factor 1	Factor 2	Factor 3
1 (E)	**0.821**	0.092	−0.036
6 (E-r)	**0.820**	−0.126	−0.087
2 (A-r)	***−0.406***	−0.044	***0.519***
7 (A)	−0.054	**0.715**	0.038
3 (C)	0.035	**0.692**	0.202
8 (C-r)	0.199	**0.488**	***0.425***
4 (ES-r)	0.272	−0.005	**0.809**
9 (ES)	−0.195	0.351	**0.626**
5 (O)	0.273	**0.532**	−0.317
10 (O-r)	***0.583***	0.185	0.116
Factor initial eigenvalue	2.224	2.050	1.164
Covariance contribution rate after rotation (%)	22.235	20.504	11.642

Notes: Extraction method: principal component analysis, eigenvalues great than 1 to extract. Rotation method: Varimax with Kaiser Normalization. Factor loadings higher than 0.40 are shown in bold. Items with high loadings but against the original instrument setting are highlighted in bold italics. r-denotes reverse-scored items.
Abbreviations: E, Extraversion; A, Agreeableness; C, Conscientiousness; ES, Emotional Stability; O, Openness.

majors had significantly different scores on Extraversion, Agreeableness, Conscientiousness and Openness (p<0.05). Birthplace and monthly consumption level had significant effects on all five factors (p<0.05).

Discussion

This study evaluated the psychometric properties of TIPI-C based on Chinese medical college students and explored the personality differences of participants. This is also the first study to evaluate the structural validity and internal consistency of TIPI-C (Minyan Huang version). Although one previous study has demonstrated sufficient psychometric properties of the TIPI-C in China,[13] our study has found a less promising result. Having said that, our finding is aligned with what the developers aimed to achieve with this brief instrument. To use this extreme brief personality instrument, the researchers need to tolerate the somewhat diminished psychometric properties.[5]

The five factors of TIPI-C showed no floor or ceiling effects, proving some supporting evidence on the sensitivity of this short instrument in measuring personality. This study found that the Cronbach's α coefficients of TIPI-C ranged from 0.119 (Agreeableness) to 0.785 (Extraversion), which was consistent with previous studies.[5,10] Existing research reported that the Japanese version of TIPI the Cronbach's α coefficients ranged from 0.28 to 0.50 in middle-aged, and ranged from 0.37 to 0.60 in older adults.[8] Furthermore, a meta-analysis has found that the Chinese version of the BFI, NEO-FFI and Big Five Mini all demonstrated substantially lower reliabilities than the original English versions.[43] The developers have noted that the lower internal consistency coefficients may owe to the few items included in the TIPI, which was designed to optimize content validity.[5] Since only two items of each dimension were included, the goal of maximizing content validity inevitably comes at the expense of internal consistency.[44]

Although Cronbach's α has been widely used to estimate the reliability, the previous study showed that the Spearman–Brown coefficient and standardized Cronbach's α coefficient will be appropriate to estimate the reliability of the two-item scale.[31] In this study, we used Spearman–Brown coefficient, standardized Cronbach's α coefficient and Cronbach's α to assess the subscale internal consistency. It has been found that the Spearman–Brown coefficient and standardized Cronbach's α coefficient were equivalent in the five subscales, and this confirmed the findings of existing studies that showed its equivalent for two-item scale.[31] Furthermore, we found that the Spearman–Brown coefficient was higher than Cronbach's α, which was consistent with previous studies.[31,45] Cronbach's α coefficient was an accurate estimate of reliability under extremely restrictive assumptions, which was inappropriate and meaningless for two-item scales.[46,47] Thus, some scholars have advocated that Spearman–Brown coefficient was more appropriate than Cronbach's α for estimation of internal consistency of two-item scales.[31,48]

Table 6 TIPI-C Scores Among Different Participants' Sociodemographic Characteristics (Mean ± SD)

	Extraversion	Agreeableness	Conscientiousness	Emotional Stability	Openness
Whole sample	4.45 ± 1.60	5.07 ± 1.06	5.31 ± 1.19	4.55 ± 1.31	4.74 ± 1.11
Sex					
Male	4.35 ± 1.60	4.88 ± 1.11	5.33 ± 1.24	4.73 ± 1.30	4.84 ± 1.17
Female	4.48 ± 1.60	5.15 ± 1.03	5.31 ± 1.18	4.48 ± 1.32	4.71 ± 1.09
P value	0.217[b]	**<0.001[a]**	0.735[b]	**<0.001[a]**	0.068[a]
Birthplace					
Urban	4.59 ± 1.63	4.89 ± 1.06	5.17 ± 1.24	4.42 ± 1.32	4.85 ± 1.12
County	4.60 ± 1.53	5.00 ± 1.09	5.23 ± 1.20	4.55 ± 1.28	4.80 ± 1.04
Rural	4.34 ± 1.60	5.18 ± 1.03	5.40 ± 1.16	4.60 ± 1.32	4.70 ± 1.13
P value	**0.001[b]**	**<0.001[a]**	**<0.001[b]**	**0.036[a]**	**0.035[a]**
Only child					
Yes	4.50 ± 1.60	4.95 ± 1.11	5.22 ± 1.22	4.55 ± 1.33	4.80 ± 1.13
No	4.42 ± 1.60	5.15 ± 1.02	5.37 ± 1.18	4.54 ± 1.31	4.72 ± 1.10
P value	0.295[b]	**<0.001[a]**	**0.006[b]**	0.913[a]	0.099[a]
Major					
Medicine	4.41 ± 1.60	5.04 ± 1.06	5.31 ± 1.27	4.59 ± 1.40	4.78 ± 1.15
Pharmacy	4.37 ± 1.56	4.97 ± 1.07	5.23 ± 1.23	4.50 ± 1.30	4.84 ± 1.10
Nursing	4.63 ± 1.58	5.21 ± 1.03	5.50 ± 1.14	4.57 ± 1.29	4.76 ± 1.07
Health care management	4.41 ± 1.64	5.09 ± 1.06	5.24 ± 1.13	4.53 ± 1.28	4.62 ± 1.12
P value	**0.035[b]**	**0.002[a]**	**<0.001[b]**	0.670[a]	**0.004[a]**
Annual family income (Chinese Yuan, CNY)					
< 30,000 CNY	4.32 ± 1.58	5.18 ± 1.09	5.37 ± 1.22	4.63 ± 1.38	4.67 ± 1.12
30,000–50,000 CNY	4.31 ± 1.63	5.10 ± 1.01	5.30 ±1.17	4.57 ± 1.27	4.68 ± 1.06
50,000–70,000 CNY	4.49 ± 1.55	5.09 ± 1.10	5.38 ± 1.16	4.55 ±1.29	4.78 ± 1.16
70,000–90,000 CNY	4.69 ± 1.48	5.07 ± 0.99	5.22 ± 1.21	4.47 ± 1.30	4.78 ± 1.04
> 90,000 CNY	4.45 ± 1.60	5.07 ± 1.06	5.31 ± 1.19	4.55 ± 1.31	4.74 ± 1.11
P value	**<0.001[b]**	**<0.001[a]**	0.169[b]	0.114[a]	**0.007[a]**
Monthly consumption level (Chinese Yuan, CNY)					
< 800 CNY	4.25 ± 1.60	5.22 ± 1.08	5.60 ± 1.08	4.68 ± 1.27	4.64 ± 1.11
800–1500 CNY	4.40 ± 1.58	5.08 ± 1.02	5.27 ± 1.21	4.54 ± 1.30	4.71 ± 1.09
1500–2500 CNY	4.91 ± 1.60	4.87 ± 1.13	5.22 ± 1.23	4.39 ± 1.39	4.94 ± 1.10
> 2500 CNY	4.79 ± 1.80	4.79 ± 1.23	5.06 ± 1.23	4.57 ± 1.46	5.37 ± 1.30
P value	**<0.001[b]**	**<0.001[a]**	**<0.001[b]**	**0.033[a]**	**<0.001[a]**

Notes: [a]One-way ANOVA; [b]Kruskal–Wallis H. Bold values indicate the p<0.05.
Abbreviation: SD, standard deviation.

In the structural validity evaluation, the CFA results were poor and the PCA found three factors, and it was similar to what has been reported in Indonesia.[38] The Indonesian study found that the result of CFA was not satisfactory and the Indonesian version of the TIPI had a poor internal structure.[38] The lack of structural validity was not unique to the brief TIPI. For example, previous studies used longer instruments among the East Asian population, which identified four factors in the five-factor model structure, and the Openness factor did not appear.[49] Furthermore, the findings from other Asian countries showed that the internal consistency of the Openness factor was low.[50,51] Our study found that the Extraversion, Conscientiousness and Emotional Stability had moderate correlation coefficients with their items, and only these three factors with eigenvalue ≥1 were extracted by PCA in the Chinese population. Significantly, it is generally not recommended to conduct CFA with less than three indicators per latent variable.[52] Given the TIPI used only two items per personality trait, this setting may influence the CFA results.

Using one to two items to measure a personality factor is a simplification of the scale. In terms of measurement theory, the accuracy of a short-length scale is generally lower than that of a long-length scale. However, the previous

study has shown that the short scales were as valid as long scales in real-world applications.[53] Each factor of TIPI was evaluated by two items, one item represents a positive pole, and the other a negative pole.[9] If the two items belonging to the same factor were similar, the reliability would increase, whereas its validity would decrease.[8] Conversely, if the two items measured a wider range of the construct, the validity would increase, and the reliability would decrease. This is referred to as the "bandwidth and the fidelity dilemma".[54]

The previous study has demonstrated sufficient psychometric properties of the TIPI-C in China.[13] However, our study found several inconsistent conclusions with the earlier study. Both the different versions of the TIPI-C used in these two studies and the different study samples may explain the differences. Our study found that the internal consistency coefficients of Agreeableness and Openness were low, which was consistent with the original scale and the German version.[3,5] In addition, the other previous study reported that Agreeableness has the lowest Cronbach's α coefficient (0.443) and the TIPI-C was not very optimistic about internal consistency among Chinese breast cancer patients.[14] The scores of East Asian populations were generally found to be lower than other samples on Agreeableness.[55,56] These results are basically consistent with our findings. More research may be needed to modify the instrument to be more suitable for the Chinese population.

This study explored the TIPI-C scores among different medical college students' sociodemographic characteristics. Compared with the Asian undergraduates,[5] the results showed that Chinese medical college students had lower scores than the Asian undergraduates on Agreeableness, Conscientiousness, Emotional Stability and Openness. We found that students from cities or with higher annual family income reported higher scores on Openness and Extraversion. This may be related to their living conditions being superior, as well as the knowledge and information sources being broader.[57] Moreover, the Openness trait has been improved with the degree of modernization increased in China.[58] Males were found to have higher scores on Emotional Stability than females. Existing research showed that males tended to be calmer than females when faced with stress and emergency.[59] These findings showed that students who were the only child had lower scores on Agreeableness and Conscientiousness, which may be because there was a lack of competition with siblings in the family. Consequently, a lack of household environment to develop a spirit of cooperation with others.[60]

In summary, despite the evidence for the value of the TIPI-C, there are some limitations to this brief instrument. Firstly, the TIPI-C had low alpha coefficients or poor factor structures in the factor analyses. Secondly, Agreeableness and Openness had poor psychometric properties in the Chinese population. The two factors' internal consistency coefficients were low and there was a poor structural validity. Future studies may consider revising the items in particular for the Agreeableness and Openness of the Chinese population. Although the reliability and structural validity results were less promising, when we aim to explore personality as one among several concepts or utilize personality traits as covariates, or encounter time constraints,[3,38,45] the TIPI could serve as an appropriate instrument.

There are several limitations to this study. Firstly, although our study recruited large medical college students, the sample was not representative of the whole population in China and this may have limited the generalizability of the findings of the study. Secondly, we were not able to evaluate the concurrent validity and the test-retest reliability in this cross-sectional survey. The future study should consider comparing the psychometric properties of TIPI-C against other longer versions of five-factor inventory (eg, BFI, BFI-2, NEO-FFI, TDA, and Big Five Mini) in China, and more research needs to explore the psychometric properties of TIPI-C among the general population.

Conclusion

The goal of the TIPI was to create a very short instrument that optimized validity (including content validity). TIPI-C primarily stands out as a feasible instrument for brief measurements of the Extraversion, Emotional Stability, and Conscientiousness domains, because these domains can demonstrate appropriate eigenvalues and estimates of internal consistency. The TIPI-C is not an appropriate instrument when comprehensive assessments of personality are required; however, when exploring personality as one among several concepts or utilizing personality traits as covariates the TIPI-C could be considered. Overall, our findings suggest the TIPI-C is suitable for research where time is limited, or where it is large survey research. Further research is required to evaluate the concurrent validity and the test-retest reliability of the TIPI-C in different populations, and potentially modify the instrument to be more suitable for the Chinese population.

Ethics Approval

The study was approved by the Ethics Review Board of the School of Preventive Medicine, Shandong University (Reference No. 20170301), and the research adhered to the tenets of the Declaration of Helsinki. Informed consent was obtained from all participants prior to questionnaire administration.

Disclosure

The authors report no conflicts of interest in this work.

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