

BMJ Open Psychometric properties of the traditional Chinese version of the youth attitude to noise scale: a cross-sectional study in a large representative sample

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ABSTRACT

Objectives This study aimed to examine the psychometric properties of the traditional Chinese version of the Youth Attitude to Noise Scale (YANS) in a large representative sample.

Design Cross-sectional study.

Setting 15 secondary schools in Hong Kong, China.

Participants 2842 adolescents aged 12–20 years participated in this study between April and July 2016.

Methods The standard forward–backward validation procedures were followed to obtain the traditional Chinese version of the YANS. Prior to the formal investigation, the YANS was evaluated by cognitive debriefing. The sample was randomly divided into two halves for exploratory factor analyses (EFAs) and confirmatory factor analyses (CFAs), respectively. The number of factors was determined by comparison data approach using EFAs, and the factor structure was confirmed by CFAs using the one-factor, four-factor and bifactor models. The scale's internal reliability, dimensionality and measurement invariance across gender and age groups were also examined.

Results EFAs (n=1338) showed that four factors were extracted, and CFAs (n=1337) demonstrated the bifactor model fitted better to the sample than the other models. Additionally, the traditional Chinese version of the YANS showed high reliability ($\omega=0.84$), a general factor, scale multidimensionality, and gender and age invariance.

Conclusions The findings of the current study indicate that the traditional Chinese version of the YANS is a feasible instrument to assess attitude to noise in Chinese adolescents, regardless of their gender and age. Given the presence of a general factor, the YANS is not merely multidimensional, and whether to use the total or subscale scores is recommended to rely on research objectives.

INTRODUCTION

As estimated by the WHO, nearly 1.1 billion young people are vulnerable to hearing loss due to loud noise exposure, including the unsafe use of personal listening devices.¹ Due to noise exposure, tinnitus has troubled 5.4%–18.3% of adolescents^{2–4} and noise sensitivity has affected 17.1%–39.2% of adolescents.^{3 4} Sleep disturbance,⁵ noise annoyance⁶ and psychotropic drug

Strengths and limitations of this study

- This was the first study to evaluate the psychometric properties of the traditional Chinese version of the Youth Attitude to Noise Scale in a large-scale representative school sample.
- The number of factors was determined by a more accurate and robust comparison, namely the comparison data technique using exploratory factor analyses.
- The factor structure was confirmed by confirmatory factor analyses using the one-factor, four-factor and bifactor models.
- In this study, participants were only recruited from school settings, therefore the current results might not be applicable to the entire youth population.
- This study did not culturally adapt other scales to assess noise-related variables, which might affect adolescents' risk perception as well as attitude to noise.

utilisation⁷ have been identified as consequences of noise sensitivity.

Although the detrimental effects of noise exposure have been well illustrated, it is not sufficient for adolescents to enhance hearing protection in noisy environments. The main reason for this could be their attitude to noise.⁸ An individual with more positive attitude to noise considers noise as less annoying and feels less motivated to use hearing protection devices in noisy surroundings.⁹ Therefore, positive attitude to noise has been regarded as a key reason for loud sound exposure without hearing protection.⁹

Appropriate measurement of attitude to noise in adolescents is essential as it provides further empirical support for the implementation of effective interventions. One of the most effective instruments to measure attitude to noise is the Youth Attitude to Noise Scale (YANS), and its original version comprised 18 items specified with four factors, namely the 'Youth culture', 'Concentrate', 'Daily noises'

and 'Intent to influence' factors.¹⁰ All items were rated on a 5-point Likert scale from 1 ('completely disagree') to 5 ('completely agree'), and a higher score reflects a more positive attitude to noise.¹⁰ Subsequently, a modified YANS with 19 items has been used in the USA,⁹ Brazil¹¹ and mainland China.¹² However, although the aforementioned studies confirmed a four-factor structure, the specific contents in each factor were not identical across cultures⁹⁻¹² and several items displayed low factor loadings (<0.4) necessitating removal.^{11 12} Moreover, internal reliabilities estimated by Cronbach's alpha were fairly low (<0.7) in some previous studies, particularly in the 'Concentrate'^{11 12} and 'Intent to influence' factors.¹² In addition, although the other specific factors and the total YANS in a few studies showed an acceptable consistency,^{9 11 12} it is controversial to evaluate a scale's reliability by Cronbach's alpha due to the possible underestimation, and using other indices, for example, the omega (ω) coefficient provides a more precise estimate.¹³

Further, considering cultural diversities, using the simplified Chinese version of the YANS, it may be hard to unambiguously determine attitude to noise held by Chinese adolescents outside mainland China, for example, Hong Kong, Macao and Taiwan, where traditional Chinese is the official written language. Therefore, although the simplified Chinese version of the YANS has been recommended as a valid tool in youths from mainland China,¹² there is no feasible version of the YANS that can be used outside mainland China.

In this context, another necessary concern regarding validation that has not been adequately examined yet is measurement invariance, which refers to the underlying constructs being examined equivalently across groups.^{14 15} This procedure is also particularly crucial in adolescents given that during adolescence, enormous physical and psychological changes occur concurrently and manifest distinctively by gender and age. For this reason, examining the gender and age invariance of the YANS enables us to confirm whether the latent constructs of the YANS are measured similarly across gender and age groups.

Given the knowledge gaps and limitations of the existing research, the current study aimed to examine the psychometric properties of the traditional Chinese version of the YANS in a representative school sample. Specifically, the objectives were: (1) to explore the factor structure of the traditional Chinese version of the YANS by exploratory factor analyses (EFAs), (2) to confirm the underlying scale structure by confirmatory factor analyses (CFAs) using the one-factor, four-factor and bifactor models, (3) to assess the scale's internal reliability, dimensionality, and measurement invariance across gender and age groups.

METHODS

Study design

This was a cross-sectional study.

Participants

Adolescence is divided into young (10–14 years), middle (15–19 years) and late (20–24 years) stages.¹⁶ Therefore, students aged 10–24 years and in grades 7–12 in Hong Kong were included and those who could not read traditional Chinese or had doctor-diagnosed hearing impairment were excluded. The sample size calculation was originally based on the estimation of the prevalence of noise exposure. With an anticipated prevalence of 5% and a 1% margin of error in a 95% CI, 1825 participants were needed.¹⁷ After accounting for incomplete responses, 2000 participants were targeted. In this study, the sample was randomly divided into two halves to conduct EFAs and CFAs, respectively. Adopting the rule of 20 participants per item for factor analysis,¹⁸ validating the modified 19-item YANS required 760 participants. Thus, 2000 participants were adequate.

Cultural adaptation to the YANS

We followed the standard forward–backward validation procedures,¹⁹ where two bilingual registered nurses independently translated the original YANS into traditional Chinese. In a consensus meeting consisting of these two translators and a researcher with prior experience in cross-cultural scale adaptations,²⁰ differences in these two Chinese versions were discussed and a consensus Chinese version was obtained. Another bilingual registered nurse who was not aware of the original English version translated the consensus Chinese version into the English version. The backward and original English versions were then compared. Therefore, a modified Chinese version was obtained and evaluated by cognitive debriefing in five Chinese adolescents with a mean age of 15.80 years (SD=2.28; range 13–18 years). The average completion time was 2.30 min (SD=0.67; range 1.5–3.0 min). The median rating of the scale length was acceptable, and that for item clarity as well as relevance was high on a 5-point Likert scale, where 0= 'very short/very low' and 4='very long/very high'.

Participants were invited to rate how they agreed with the statements regarding their attitude to noise. Items 1, 3, 4, 7, 8, 12, 13, 15, 18 and 19 were scored inversely in the modified 19-item YANS.^{2 10} However, as the item 8 'Do not like quiet' reveals a positive attitude to noise, items 1, 3, 4, 7, 12, 13, 15, 18 and 19 were scored inversely in this study. The sum of the total YANS score ranged from 19 to 85, with a higher YANS score indicating more positive attitude to noise.

Additionally, participants' sociodemographic information, including their age, gender and study grade, was also collected.

Procedures

This study was conducted between April and July 2016. Based on the list of public secondary schools available from the Hong Kong Education Bureau, one secondary school in each district was selected randomly and sent an invitation letter. Finally, 15 schools were recruited in

our study. Before the day when students participated, we explained the study procedures in detail to their parents and required them to give back a signed note if they disagreed with their children's participation. Students were also informed of the study details and signed an informed consent form before they engaged. Teachers in the schools helped us to disseminate the questionnaires, and it took each student around 25 min to complete.

Statistical analyses

Summary

In the entire dataset, missing values were replaced by the mean values of the observed item responses in each case, where no less than 50% of items were answered.²⁰ The total score and each subscale score were standardised onto a 0–100 scale, respectively.²⁰ In addition, the floor and ceiling effects were also calculated. A percentage of less than 15% was considered as no substantial floor or ceiling effects.²¹

Descriptive statistics were used to summarise the sample characteristics. To examine the factor structure of the YANS, the sample was randomly divided into two halves, with one half serving as the training set for EFAs, and the other half serving as the validation set for CFAs.²⁰ General analyses and EFAs were conducted in IBM SPSS V.25.0, while CFAs were performed in RStudio V.1.2.5042 using package 'lavaan'.²² The nominal level of significance was set as 0.05 in all statistical analyses.

Exploratory factor analyses

EFAs were conducted using maximum likelihood estimation with promax rotation. The number of factors was determined using the comparison data technique, which has been proven to be more accurate and robust than the other methods.^{20–23} Any item with communality less than 0.10 or a factor loading of magnitude smaller than 0.40 was removed.^{20–24}

Confirmatory factor analyses

Subsequently, CFAs were conducted using the validation set to evaluate the fitness of the factor structure derived from EFAs. Item responses were regarded as ordinal data, and the diagonally weighted least squares estimator was selected. In a bifactor model, the general factor is restricted to be uncorrelated with specific factors, whereas specific factors can intercorrelate or not.^{25–26} Given that the correlations among the specific factors of the YANS possibly existed, the specific factors were allowed to intercorrelate in the bifactor model in this study. In accordance with the theoretical framework related to attitude to noise, three models were assessed: (1) the one-factor model, (2) the four-factor model and (3) the bifactor model (figure 1).

As χ^2 statistic shows high sensitivity to a large sample,²⁷ the goodness-of-fit of the CFA models was measured by the root mean square error of approximation (RMSEA), standardised root mean square residual (SRMR),

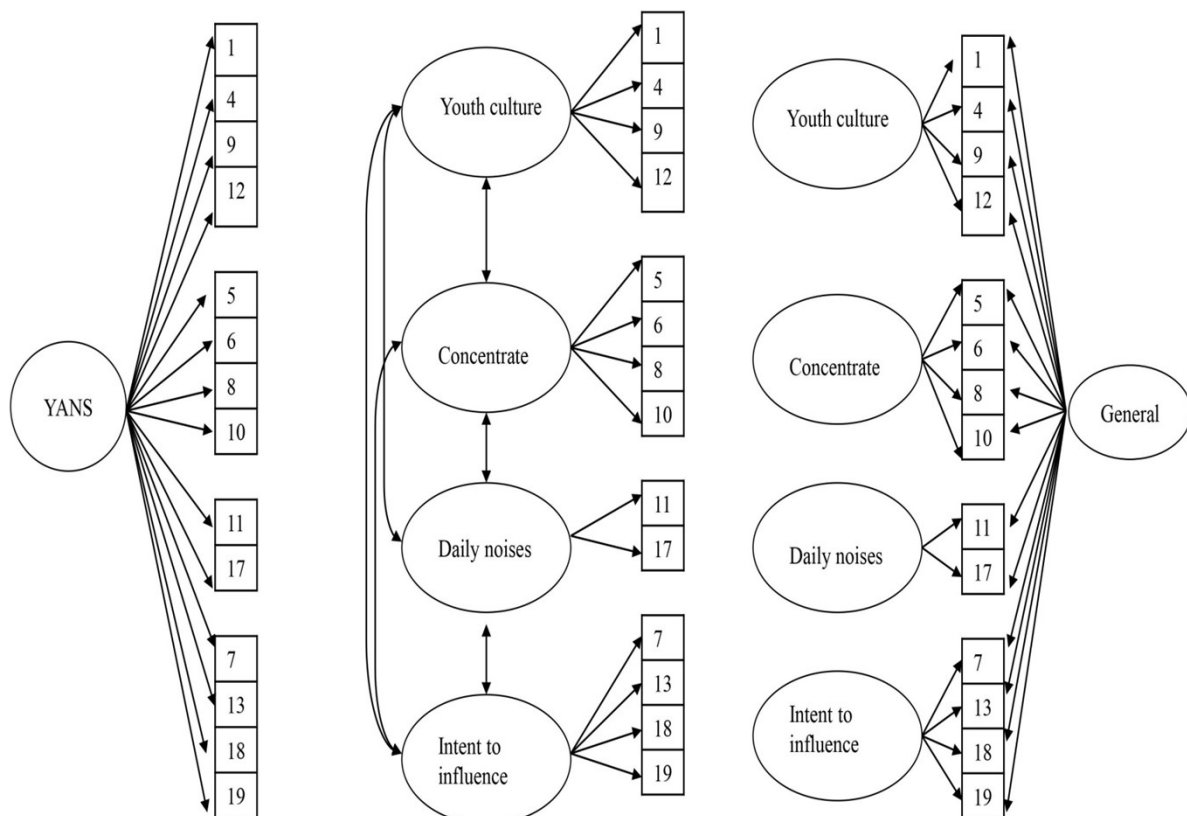


Figure 1 The one-factor, four-factor and bifactor models of the traditional Chinese version of the YANS. YANS, Youth Attitude to Noise Scale.



comparative fit index (CFI) and the Tucker-Lewis Index (TLI).²⁸ A CFA model is adequately fitted when RMSEA and SRMR <0.08, whereas CFI and TLI >0.95.^{28 29}

Examination of internal reliability

The internal reliability was examined by the ω coefficient,^{30 31} which conquers deficiencies of Cronbach's alpha given the assumption of tau equivalence.¹⁵ An ω value of at least 0.70 for the general factor indicates a reliable total score.³² Likewise, the ω value for a subscale (ω_s) should be above 0.50, and a preferred value is approximately 0.75, indicating a reliable subscale score after controlling the effects of the general factor.³³ Moreover, the ω hierarchical (ω_H) value of the total scale was calculated to determine the degree of total score variance that could be explained by the general factor.³³ The ω_H value for the general factor greater than 0.50 suggests a meaningful description, and that greater than 0.80 indicates essential scale unidimensionality.^{24 34} In addition, the ω_H for a subscale (ω_{HS}) reflects the proportion of subscale score variance that can be attributed to the specific subscale, and a moderately substantial value of ω_{HS} is suggested to be at least 0.20.³⁵ Moreover, a higher value of ω_s than ω_{HS} in each subscale implies that a considerable proportion of subscale scores variance could be explained by the general factor rather than the specific factors.³⁶

Evaluation of scale dimensionality

The standardised factor loadings for the one-factor, four-factor and bifactor models were also estimated. Unidimensionality can be concluded when the factor loadings of the general factor in the bifactor model are higher than those in the one-factor model, whereas the factor loadings of the specific factors in the bifactor model are lower than those in the four-factor model.³⁷ In contrast, lower factor loadings of the general factor in the bifactor model than those in the one-factor model and higher factor loadings of the specific factors in the bifactor model than those in the four-factor model provide evidence for multidimensionality.³⁷ Further, the explained common variance (ECV) is regarded as the quotient of the division of the explained variance attributed to the general factor by the variance attributed to the general and specific factors.³⁸ An ECV value of 0.50 implies that the general and specific factors equally account for the common variance,³⁸ and an ECV value of at least 0.70 supports a unidimensional model.²⁴ In addition to the ECV, the percentage of uncontaminated correlations (PUC), which refers to 'the number of uncontaminated correlations divided by the number of unique correlations',³⁹ is another indicator of dimensionality. Both ECV and PUC are suggested to be greater than 0.70, which indicates a unidimensional model.³⁶ Nevertheless, when the PUC value is smaller than 0.80, the cut-off points 0.60 for the ECV and 0.70 for the ω_H for the general factor should be selected to evaluate a unidimensional model.^{24 40}

Additionally, the H index was used to measure the construct replicability, and an H index value above 0.80

reveals a well-defined latent variable.³⁶ In this study, bifactor statistical indices were calculated using the package 'BifactorIndicesCalculator'.⁴¹

Measurement invariance analyses

We further assessed measurement invariance for the best-fitting model by gender and age using multiple group CFA models. Comparing two nested models, a change of RMSEA (Δ RMSEA) <0.015, a change of SRMR (Δ SRMR) <0.030 and a change of CFI (Δ CFI) <0.010 suggested invariance.⁴²

Patient and public involvement

There was no patient or public involvement in this study.

RESULTS

Sample characteristics

A total of 2842 participants were recruited in this study. In our sample, 167 participants did not answer all items of the YANS but responded to more than 50% items of the YANS. Therefore, they were not included in the factor analyses. The remaining sample of 2675 participants was spilled randomly, with 1338 participants in the training set for EFAs and 1337 participants in the validation set for CFAs, respectively. In the entire sample, participants were aged between 12 and 20 years, with a mean age of 15.24 years (SD=1.59), and 55.2% of participants were female. Participants were almost equally distributed in each grade. As indicated in [table 1](#), gender and age differences between the factor and non-factor analysis sample were insignificant ($p>0.05$).

Exploring the factor structure of the YANS

The training set comprised 1338 participants, and comparison data method indicated that four factors explained 35.9% of total variance would be optimal. Using maximum likelihood estimation to extract factors, items Q2, Q3, Q14, Q15 and Q16 with rotated factor loadings less than 0.4 or communalities less than 0.1 were removed.

Confirming the factor structure of the YANS

[Table 2](#) shows CFA fit indices for the one-factor, four-factor and bifactor models of the YANS. Overall, the one-factor model did not exhibit satisfactory fits. The four-factor model adequately fitted to the sample, better than the one-factor model. Nevertheless, the bifactor model fitted best to the sample among the three models.

Factor intercorrelations

Generally, regarding the correlated four-factor model, significant and moderate-to-strong correlations were observed among the latent constructs. All correlation coefficients were no smaller than 0.30 ($p<0.05$) with two exceptions, the correlation between the 'Daily noises' and 'Youth culture' factors being 0.18 ($p<0.05$) and between the 'Daily noises' and 'Intent to influence' factors being 0.11 ($p<0.05$).

Table 1 Characteristics of the Chinese adolescents

Characteristics	Total sample	Factor analysis sample	Non-factor analysis sample	P value*
n	2842	2675	167	
Gender, n (%)				0.806
Male	1201 (42.3)	1130 (42.2)	71 (42.5)	
Female	1569 (55.2)	1480 (55.3)	89 (53.3)	
Missing	72 (2.5)	65 (2.4)	7 (4.2)	
Age (years, n (%))				0.867
12–14	986 (34.7)	927 (34.7)	59 (35.3)	
15–20	1847 (65.0)	1740 (65.0)	107 (64.1)	
Missing	9 (0.3)	8 (0.3)	1 (0.6)	
Age (years, mean±SD†)	15.24±1.59	15.24±1.59	15.17±1.64	
Grade, n (%)				0.464
7	562 (19.8)	523 (19.6)	39 (23.4)	
8	462 (16.3)	438 (16.4)	24 (14.4)	
9	666 (23.4)	626 (23.4)	40 (24.0)	
10	591 (20.8)	554 (20.7)	37 (22.2)	
11	535 (18.8)	511 (19.1)	24 (14.4)	
Missing	26 (0.9)	23 (0.9)	3 (1.8)	

*Estimated by Pearson's χ^2 test and non-missing data in both factor and non-factor analysis samples.

†The mean age (SD) was calculated by excluding missing values.

Internal reliability

The ω for the general factor was 0.84, indicating high reliability (table 3). The ω_s was between 0.62 and 0.85, revealing moderate-to-high reliability. The ω_H for the general factor was 0.65, which was slightly lower than the cut-off value of 0.80.^{24 34} The ω_{HS} was moderate to substantial in all subscales except for the 'Concentrate' factor with a low ω_{HS} value of 0.06.

Standardised factor loadings and dimensionality

Table 3 displays the standardised factor loadings for the one-factor, four-factor and bifactor models. Overall, the standardised factor loadings of the general factor in the bifactor model were comparable with those in the one-factor model. Mean absolute difference of factor loadings was 0.09 (SD=0.07; ranging between 0.01 and 0.24). Additionally, the standardised factor loadings of the

specific factors in the bifactor model were considerably lower than those in the four-factor model. Mean absolute difference of factor loadings was 0.30 (SD=0.21; ranging between 0.05 and 0.72). This was the first evidence that revealed the presence of a general factor. Additionally, a high ω value was found in the general factor (ie, 0.84), demonstrating a reliable total score. Moreover, all ω_s values were higher than ω_{HS} , implying that the major subscale score variance was accounted for by the general factor. In addition, only the general factor had an H index value above 0.80, indicating the strength of a stable general factor. All these results, together with moderate-to-strong intercorrelations of latent factors in the four-factor model, pointed out that the general factor in the bifactor model had a significant impact on the common variance.

Table 2 Fit indices for the CFA models of the YANS in Chinese adolescents (n=1337)

Fit indices	One-factor model	Four-factor model	Bifactor model*
χ^2 (df)	2780.3(77)	644.3(71)	215.8(57)
RMSEA (90% CI)	0.162 (0.157 to 0.167)	0.078 (0.072 to 0.083)	0.046 (0.039 to 0.052)
SRMR	0.109	0.058	0.034
CFI	0.842	0.967	0.991
TLI	0.814	0.957	0.985

*Given that the correlations among the group factors possibly existed, the group factors were allowed to intercorrelate in the bifactor model. CFA, confirmatory factor analysis; CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual; TLI, Tucker-Lewis Index; YANS, Youth Attitude to Noise Scale.



Table 3 Standardised factor loadings and other statistics for the CFA models of the traditional Chinese YANS (n=1337)

Item	One-factor		Four-factor				Bifactor*				
	YANS	Total	Youth culture	Concentrate	Daily noises	Intent to influence	General	Youth culture	Concentrate	Daily noises	Intent to influence
1	0.741	0.770					0.679	0.396			
4	0.673	0.705					0.622	0.351			
9	0.827	0.846					0.820	0.198			
12	0.668	0.700					0.602	0.405			
5	0.229	0.301					0.347		0.122 ns		
6	0.600	0.752					0.677		0.028 ns		
8	0.415	0.493					0.493		0.058 ns		
10	0.377	0.485					0.520		0.121 ns		
11	0.428				0.938		0.419			0.629	
17	0.309				0.661		0.293			0.791	
7	0.323					0.476	0.175				0.430
13	0.432					0.623	0.283				0.461
18	0.385					0.607	0.147				0.726
19	0.331					0.474	0.186				0.412
						ω/ω_s	0.842	0.849	0.625	0.775	0.624
						ω_H/ω_{HS}	0.650	0.247	0.059	0.684	0.580
						H index	0.843	0.471	0.134	0.751	0.647

Significant factor loadings: $p < 0.05$.

*The group factors were allowed to intercorrelate in the bifactor model.

CFA, confirmatory factor analysis; ω_H , omega hierarchical; ω_{HS} , omega hierarchical for a subscale; ns, non-significant; ω_s , omega value for a subscale; YANS, Youth Attitude to Noise Scale.

On the other hand, all the items loaded strongly (>0.40) on the specific factors of the four-factor model with only an exception of item 5 (0.30), which provided an indication of a multidimensional model. Moreover, the values of PUC, ECV and ω_H for the general factor were 0.79 (<0.80), 0.49 (<0.60) and 0.65 (<0.70), respectively. Given that all ω_s values were greater than the acceptable criteria of 0.50,³³ in combination with moderately substantial ω_{HS} values for the three subscales, which failed to support essential unidimensionality of the YANS, a multidimensional model should be considered. In the same vein, high H index values were also found for the 'Daily noises' and 'Intent to influence' factors (ie, 0.75 and 0.65, respectively), and thus the scale multidimensionality was recommended.

Scale summary

Participants had a mean total score of 44.37 (SD=13.00). The total YANS reported no ceiling and a 0.1% floor rate. The floor and ceiling percentages in the subscales were 1.5%–4.2% and 0.7%–2.8%, respectively. This result revealed that although the total scale and subscales differed in item responses, they did not demonstrate floor and ceiling effects.

Measurement invariance

As there were just 13 participants (0.5%) aged 20 years, we assessed measurement invariance only between 12–14 years and 15–20 years age group. Generally, the bifactor models satisfactorily fitted to the data in age and gender subgroups and demonstrated measurement invariance. Specifically, indices values were RMSEA ≤ 0.055 , SRMR ≤ 0.042 , CFI ≥ 0.982 and TLI ≥ 0.975 (table 4) in

all subgroups. Regarding participants' gender, configural invariance was well established (RMSEA=0.051, SRMR=0.038, CFI=0.988, TLI=0.980) and metric invariance was found (Δ RMSEA ≤ 0.002 , Δ SRMR ≤ 0.004 and Δ CFI ≤ 0.004). Further, scalar invariance was determined (Δ RMSEA ≤ 0.003 , Δ SRMR ≤ 0.001 and Δ CFI ≤ 0.002). This provided valid evidence that the latent constructs of the YANS were examined similarly between male and female adolescents. Correspondingly, configural, metric and scalar invariances in both 11–14 years and 15–20 years age groups were confirmed as well, as the fit index changes between nested models did not exceed the recommended benchmarks (Δ RMSEA < 0.015 , Δ SRMR < 0.030 and Δ CFI < 0.010).⁴²

DISCUSSION

To our knowledge, this is the first study to evaluate the psychometric properties of the traditional Chinese version of the YANS in a large-scale representative school sample. Specifically, EFA results suggested that 14 items loaded on four factors should be retained. Subsequently, we confirmed the factor structure of the YANS by performing one-factor, four-factor and bifactor models. Factor loadings of these three models in conjunction with the bifactor statistical indices showed a general factor of the YANS, scale multidimensionality and high-scale internal reliabilities. Lastly, our research findings showed that the YANS had no floor and ceiling effects and was measurement invariant across age and gender groups.

The evidence for a general factor of the YANS could be found from similar factor loadings on the general factor

Table 4 Gender and age invariance for the bifactor model of the traditional Chinese YANS

	χ^2 (df)	RMSEA (90% CI)	SRMR	CFI	TLI	Δ RMSEA*	Δ SRMR*	Δ CFI*
Gender††								
Male (n=1130)	204.962(57)	0.048 (0.041 to 0.055)	0.034	0.990	0.984			
Female (n=1480)	316.297(57)	0.055 (0.050 to 0.062)	0.040	0.984	0.975			
Configural invariance	504.427(114)	0.051 (0.047 to 0.056)	0.038	0.988	0.980			
Metric invariance	642.789(137)	0.053 (0.049 to 0.057)	0.042	0.984	0.979	0.002	0.004	0.004
Scalar invariance	733.719(174)	0.050 (0.046 to 0.053)	0.041	0.982	0.981	0.003	0.001	0.002
Age‡‡								
12–14 (n=927)	205.765(57)	0.053 (0.045 to 0.061)	0.040	0.987	0.979			
15–20 (n=1740)	286.359(57)	0.048 (0.043 to 0.054)	0.034	0.989	0.982			
Configural invariance	492.124(114)	0.050 (0.045 to 0.054)	0.036	0.988	0.981			
Metric invariance	633.262(137)	0.052 (0.048 to 0.056)	0.040	0.984	0.979	0.002	0.004	0.004
Scalar invariance	738.040(174)	0.049 (0.046, 0.053)	0.039	0.982	0.982	0.003	0.001	0.002

*The absolute value was reported.

†The gender invariance analysis using the study sample, excluding 65 cases with missing value in the gender variable.

‡The age invariance analysis also using the study sample, excluding eight cases with missing value in the age variable.

Δ CFI, changes of CFI in comparison with the prior less restrained model; CFI, comparative fit index; Δ RMSEA, changes of RMSEA in comparison with the prior less restrained model; RMSEA, root mean square error of approximation; Δ SRMR, changes of SRMR in comparison with the prior less restrained model; SRMR, standardised root mean square residual; TLI, Tucker-Lewis Index; YANS, Youth Attitude to Noise Scale.

in the bifactor model to those of the one-factor model. An additional indication for a general factor was that items loaded less strongly on the specific factors in the bifactor model than in the four-factor model. In addition, a high ω value was found in the general factor (ie, 0.84), which was indicative of a reliable total score. Moreover, a higher value of ω_s than ω_{HS} was found in each subscale, which further enhanced the presence of a general factor. Additional evidence for a general factor was the high H index value (>0.80) only found for the general factor, pointing to the general factor with a well-defined definition that could be measured precisely by its response items,³⁶ which again supported the strength of a stable general factor. Furthermore, regarding the correlated four-factor model, latent factors were intercorrelated moderately to strongly, except for the less strong correlation coefficients between the 'Daily noises' and 'Youth culture' factors and between the 'Daily noises' and 'Intent to influence' factors, which were similar to the findings reported by Widen *et al*⁹ and Zhu *et al*.¹² Although the less strong coefficients might be explained by the small number (ie, two) of items with salient factor loadings on the 'Daily noises' factor, this result indicated that although each factor best represented a specific meta-construct of attitude to noise, a common underlying construct was shared among factors. Combining these findings, it was reasonable to conclude that the general factor had substantial effects on the overall variance of the YANS.

On the other hand, there was sufficient evidence supporting that the constructs of the YANS were conceptualised as multidimensional. First, prior to EFAs, four factors were extracted. Second, after removing 5 items loaded poorly onto the specific factors, 14 retained items had strong factor loadings (>0.40) and adequate communalities (>0.10). This finding was confirmed by the standardised factor loadings for the correlated four-factor model. Although item 5 had a less strong factor loading on the 'Concentrate' factor (ie, 0.30), all the other retained items loaded strongly on the specific factors with standardised factor loadings ranging from 0.47 to 0.94. Third, although the bifactor model showed a good fit to the data, the ECV in the present study was somewhat low. Given that PUC was below 0.80, the benchmarks for ECV above 0.60 and ω_H for the general factor above 0.70 were used to confirm a unidimensional model.⁴⁰ In the present study, given the values of PUC being 0.79, ECV being 0.49 as well as ω_H for the general factor being 0.65, a four-factor model should be proposed. Fourth, the relatively high ω values were also identified in the 'Youth culture' (0.85), 'Daily noises' (0.78), 'Concentrate' (0.63) and 'Intent to influence' factors (0.62), which were all higher than the benchmark 0.50,³³ representing reliable subscale scores of distinct dimensions. Therefore, taken together with approximately 50% of variance that could be explained by the specific factors rather than the general factor, the uncertainty to calculate the YANS score from separate subscales was reduced. Further evidence for a multidimensional model was detected from moderately substantial

values of ω_{HS} (≥ 0.20).⁴¹ In the current study, the ω_{HS} values were moderately substantial in all subscales except for the 'Concentrate' factor with a low ω_H value of 0.06. Thus, it was reasonable to conclude a multidimensional model. Lastly, similar to the general factor, the H index values of the two specific factors, namely the 'Daily noises' and 'Intent to influence' factors, were also relatively high. This illustrated that to some extent, latent variables could be described precisely by the subscale scores.³⁶

Given that a general factor of the YANS was identified, although the multidimensional nature of the scale was determined, it was not recommended to evaluate subscale scores in each case due to the potential confounding relationships of the general factor with the specific factors using modelling approaches other than the bifactor analysis, in which confounding effects were removed.¹⁵ Therefore, we suggested that the determination should depend on research interest. Under some conditions, although it might be encouraging to use the total YANS score rather than the subscale scores, an important aspect was that the overall variance of the total score consisted of not only the variance accounted for by the general factor but also the variance explained by the specific factors. As such, it was essential to present the means of the total YANS score and its associations with other latent variables with caution.^{30 43} Additionally, for further use of the scale, another necessary task was to externally validate the YANS using a bifactor structure within structural equation modelling and to investigate the significant conceptual associations among the general and specific factors of the YANS as well as other predicted variables, for instance, hearing protection.⁹

Although the current study advances our understanding of the psychometric properties of the YANS, there are several limitations. First, participants were only recruited from school settings, which warranted sample homogeneity. However, the current results might not be applicable to the entire youth population, and future research may recruit more diverse samples from various settings (eg, clinical or community settings). Second, regarding the age range, adolescence lasts between 10 and 24 years. However, our participants were 12–20 years, which again limited our study findings to represent those of all the adolescents. Third, this study did not culturally adapt other scales to assess noise-related variables, for example, noise sensitivity^{3 4} and noise annoyance,⁴⁴ which might affect adolescents' risk perception as well as attitude to noise. Therefore, it will be worthy for future studies to explore the associations among attitude to noise, noise sensitivity and noise annoyance by using separate scales, for instance, the YANS, the²⁰Weinstein's Noise Sensitivity Scale and the Annoyance Index⁴⁴ to strengthen the applicability of the YANS. Fourth, we did not investigate the test–retest reliability of the YANS, which is suggested to be tested in future studies to have a comprehensive understanding of the psychometric nature of the YANS. Lastly, regarding a bifactor model, it is more likely to exhibit satisfactory fits than the other models.³⁷ As such, it should

not be neglected that the bifactor analysis may build an overfit model as a result of its innate traits. Nevertheless, the bifactor approach enables us to identify whether there is a general factor that can be precisely described by the total score or whether it is plausible to use the subscale scores.³⁷

CONCLUSIONS

The traditional Chinese version of the YANS is a feasible instrument to assess attitude to noise in Chinese adolescents, regardless of their gender and age. Although the YANS is primarily multidimensional in nature, the general factor accounted for a considerable proportion of total variance. Therefore, the constructs of the YANS are not merely multidimensional, and whether to use the total or subscale scores should rely on research interest. Future research is also suggested to assess the relationships among the general and specific factors of the YANS as well as other predicted variables by structural equation modelling, which will expand the literature by adding more important information provided by the general and specific factors.

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