



Chinese translation of the Clinical Impairment Assessment (CIA 3.0): Psychometric properties and measurement invariance across sex and age in adolescents, young adults, and adult men

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ARTICLE INFO

Keywords:

Clinical Impairment Assessment
Psychosocial impairment
Eating disorders
Psychometric properties
Chinese

ABSTRACT

The Clinical Impairment Assessment (CIA) is the most widely used instrument for assessing psychosocial impairment related to eating disorders (EDs). The CIA was translated into Chinese based on standard procedures. The psychometric properties of the Chinese CIA (C-CIA) were assessed among four adolescent and adult samples [i.e., 792 junior high school students (47.0% boys; $M_{age} = 13.09$ years), 1324 senior high school students (44.2% boys; $M_{age} = 16.06$ years), 812 undergraduate students (36.3% boys; $M_{age} = 18.88$ years), and 406 male adults from a general population ($M_{age} = 28.53$ years)]. The three-factor structure of the CIA was replicated. Excellent internal consistencies of the C-CIA were revealed, $\alpha = 0.93$ – 0.98 . The C-CIA showed moderate and good test-retest reliability in a six-month interval for junior high school students ($ICC = 0.69$) and senior high school students ($ICC = 0.76$), respectively. The C-CIA had good test-retest reliability in a two-week interval for undergraduate students ($ICC = 0.78$) and general adult men ($ICC = 0.81$). Our results supported good construct validity, known-group validity of the C-CIA, and measurement invariance across sex and age. These findings suggest that the C-CIA can be a useful tool assessing psychosocial impairment related to EDs for Chinese adolescents, young adults, and adult men.

1. Introduction

A recent epidemiological study in mainland China found comparable prevalence of disordered eating to rates of disordered eating and eating disorders (EDs) worldwide (Yao et al., 2021). Such research, alongside growing interest in EDs in non-Western populations, suggests the need for culturally competent and valid psychometric assessments examining EDs and related psychopathology (Swami & Barron, 2019). Psychosocial impairment related to ED psychopathology is a crucial aspect of ED diagnosis and can guide assessment, prevention, and treatment of EDs in both clinical and nonclinical samples (Bohn & Fairburn, 2008; Rø et al., 2012).

The Clinical Impairment Assessment (CIA 3.0; Bohn & Fairburn, 2008) is the most widely used tool measuring ED-related psychosocial impairment (Raykos et al., 2019). Since the development of the CIA in 2008 (Bohn & Fairburn, 2008), a number of studies have supported the

sound psychometric properties (e.g., adequate reliability and validity) across different countries (e.g., Fiji, Japan, Norway, UK, South Korea, Spain, Sweden) among clinical samples with EDs (e.g., Bang et al., 2018; Horie et al., 2020; Jenkins, 2013; Martín et al., 2015; Raykos et al., 2019; Welch et al., 2011) and nonclinical samples (e.g., Becker et al., 2010; Raykos et al., 2019; Reas et al., 2010; Sahlan et al., 2021). However, to our knowledge, the CIA has not been translated and/or validated in either clinical or nonclinical Chinese populations. Given the increasing prevalence of EDs in Asian countries, including China (Pike & Dunne, 2015; Sun et al., 2020), and the importance of evaluating functional impairment in EDs (Bohn & Fairburn, 2008), it is relevant and timely to translate the CIA into Chinese. Therefore, we aimed to translate and examine the psychometric properties of the CIA in Chinese samples (C-CIA). Furthermore, to establish the clinical utility of the C-CIA, we examined whether C-CIA scores could discriminate between individuals with high ED symptomatology and below a clinical cutoff for

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<https://doi.org/10.1016/j.eatbeh.2022.101623>

Received 14 August 2021; Received in revised form 23 December 2021; Accepted 6 March 2022

Available online 14 March 2022

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ED symptomatology.

Measurement invariance assesses whether an instrument measures similar constructs with the same structure across different groups (Van de Schoot et al., 2012) to ensure that group comparisons are both meaningful and valid (Lee, 2018). To date, the CIA has been used in both males and females (e.g., Cooper et al., 2020) as well as in individuals of different age groups [e.g., adolescents (Becker et al., 2010), young adults (Wilksch et al., 2018), adults from general populations (Cooper et al., 2020)]. Studies have also provided sex differences (e.g., Dahlgren et al., 2017; Sahlan et al., 2021) and age differences (e.g., Jenkins & Price, 2018; Rø et al., 2012) in the CIA total scores. For example, Dahlgren et al. (2017) found that males had lower global CIA scores than females; and Rø et al. (2012) compared four female samples with different ages in CIA total scores, found that late adolescent females aged 16–20 years had the highest CIA scores while those aged 41–50 had the lowest CIA total scores. However, to our knowledge, limited studies have examined the sex or age invariance of the CIA, which serves as the basis of conducting sex or age comparisons in CIA total scores. Thus, the second aim of the current study was to examine the sex and age invariance of the C-CIA to verify whether the C-CIA measures the same construct (i.e., psychosocial impairment) among individuals of different sex and/or age.

To achieve these research aims, we conducted four studies (a total of 4342 individuals initially participated, but 3334 (76.78%) of them were finally included by providing valid responses, which were confirmed by two attention check questions). Study 1 examined the psychometric properties of the C-CIA in junior and senior high school students. Study 2 examined the psychometric properties of the C-CIA in undergraduate students. Study 3 examined the psychometric properties of the C-CIA in a male adult sample. We added this sample because of the limited research in male adult samples, with previous research predominantly focusing on females (Richson et al., 2021). Finally, Study 4 examined the age invariance of the C-CIA across the four samples. Based on previous findings (e.g., Bang et al., 2018; Horie et al., 2020; Raykos et al., 2019), we hypothesized that: 1) the C-CIA would demonstrate a three-dimensional factor structure; 2) the C-CIA would demonstrate good or high internal consistency reliability and test-retest reliability; 3) the C-CIA scores would show positive associations with eating disorder symptomatology, body dissatisfaction, and psychological distress but negatively relate to well-being measures (e.g., happiness); and 4) participants at high risk of an ED would have significantly higher scores on the C-CIA than those not at high risk of an ED. We did not make any hypotheses regarding the sex and age invariance of the C-CIA, instead leaving these exploratory due to the relative scarcity of related literature.

2. Study 1

The objective of Study 1 was to examine the psychometric properties and measurement invariance by sex for the C-CIA among junior and senior high school students.

3. Method

3.1. Participants and procedure

The current study is a part of a large-scale longitudinal study examining media usage, eating behaviors, body image, and health among Chinese adolescents (Tie et al., 2021). The project was approved by the research ethics of Hengyang Normal University. We obtained informed consent from all participants and their custodians. The project finally involved 2713 adolescents from one junior and one senior high school in Hunan Province. Four teachers responsible for psychological health classes administered the survey during their weekly classes. Currently, we have collected four waves of data for the longitudinal project. As the C-CIA was included in the third wave of data collection,

the current study was based on data from this third-time point, with a sample comprising 2166 adolescents. The younger cohort comprised 792 junior high school students (372, 47%, males), aged 13.09 years ($SD = 0.51$), with an average of the age and sex standardized body mass index (BMI z-score) was 0.04 ($SD = 1.08$). The senior cohort included 1324 senior high school students (585, 44.2% males), with a mean age of 16.06 years ($SD = 0.54$) and average BMI z-score of -0.12 ($SD = 0.94$). In addition, to calculate the test-retest reliability, 492 of the 792 junior high school students (141, 33.3% males) and 941 of the 1324 senior high school students (292, 31.0% males) completed the C-CIA six months after their previous assessment (i.e., the third wave of data collection).

3.2. Translation of the CIA

Following the recommended translation procedures (Beaton et al., 2000), two bilingual Ph.D. students in psychology first independently translated the English version of the CIA to Chinese (Mandarin). The research team then compared the two translations leading to a synthesized translation (C-CIA). Another two bilingual Ph.D. students in psychology, with no prior knowledge of the original English version of the CIA, back-translated this synthesized C-CIA. We forwarded this back-translation for review and approval to the authors of the CIA prior to a final review of all forward and backward translations and generation of a penultimate version of the C-CIA by the research team. Following this, we administered the pre-final C-CIA to 32 undergraduate students. Participants reported during a post-survey interview that all items of the CIA Chinese translation were clear and easy to understand. A follow-up pilot of this preliminary C-CIA in 30 high school students further supported the clarity and accurate interpretability of items. Thus, the research team approved the pre-final Chinese translation in current and subsequent studies.

3.3. Measures

3.3.1. Psychosocial impairment

The CIA 3.0 (Bohn & Fairburn, 2008) is a 16-item self-report instrument assessing psychosocial impairment due to eating disorder features in the past 28 days. Items are rated on a four-point Likert-type scale, ranging from 0 “Not at all” to 3 “A lot.” Items are summed to generate a total/global CIA score (ranging 0 to 48), with higher scores indicating greater psychosocial impairment. The original English CIA contains three factors representing domains of impairment, including personal impairment (6 items), cognitive impairment (5 items), and social impairment (5 items). However, Raykos et al. (2019) recommends use of total scores due to the large overlap between the three subscales.

3.3.2. Eating disorder symptomatology

The 12-item self-report Eating Disorder Examination Questionnaire (EDE-QS; Gideon et al., 2016) examines eating disorder symptomatology over the past seven days. Items are rated on a four-point frequency scale, ranging from 0 (“0 day”) to 3 (“6–7 days”). The total score, ranging from 0 to 36, represents a global indicator of eating disorder symptomatology, with higher scores indicating higher eating disorder symptomatology. A cutoff score of 15 for the EDE-QS is recommended for screening purposes (Prnjak et al., 2020). Recent findings suggest the Chinese version of EDE-QS had strong reliability and validity (He, Sun, et al., 2021). In the current study, the Cronbach's α of the EDE-QS was 0.90 and 0.88 for the junior and senior high school student samples, respectively.

3.3.3. Body dissatisfaction

Participants completed the nine-item body dissatisfaction subscale of the Eating Disorder Inventory (EDI-BD; Garner et al., 1983). Items are rated on a six-point Likert-type scale from 1 “Never” to 6 “Always,” with higher total scores indicating higher levels of body dissatisfaction. EDI

scores possess good reliability and validity in Chinese clinical and nonclinical populations (Leung et al., 2004; Tseng et al., 2014). We found excellent internal consistency of the EDI-BD for the junior and senior high school student samples, $\alpha = 0.92$ and 0.90 , respectively.

3.3.4. Psychological distress

The 6-item Kessler Psychological Distress Scale (K6; Furukawa et al., 2003) assesses psychological distress during the past four weeks. Items are rated on a five-point frequency scale from 0 “None of the time,” to 4 “All of the time,” with higher total scores suggesting greater psychological distress. The Chinese version of the K6 possesses good psychometric properties (Kang et al., 2015), and we found a Cronbach's α of 0.91 and 0.86 for the junior and senior high school student samples, respectively.

3.3.5. Happiness

The Single-Item Happiness Scale (Fordyce, 1988) assesses happiness as a marker of general well-being. The item states, “Do you feel happy in general?”. Respondents rate the item on a five-point Likert scale from 1 “Very unhappy” to 5 “Very happy.” This single-item for assessing happiness has demonstrated reliability and validity (Abdel-Khalek, 2006), with the Chinese translation widely used to assess general well-being, especially in large scale surveys (Su et al., 2018).

3.4. Data analysis

Data were analyzed in R 4.0.3 (R Core Team, 2020). We calculated BMI z-scores via the *childsds* package (Vogel, 2020) using BMI percentile and z-scores for Chinese children (Zong & Li, 2013). Confirmatory factor analysis (CFA) was conducted via the *lavaan* package version 0.6–7 (Rosseel, 2012). We employed mean- and variance-adjusted weighted least squares estimator (WLSMV) for model estimation as this method is generally superior to other estimators for ordinal responses (Li, 2016). We examined model fit following recommendations outlined by Hu and Bentler (1999), including comparative fit index (CFI; $\geq 0.95/0.90$ indicates a good/acceptable fit), Tucker–Lewis index (TLI; $\geq 0.95/0.90$ indicates a good/acceptable fit), and standardized root mean square residual (SRMR; $\leq 0.06/0.08$ indicates a good/acceptable fit). We did not use root mean square error of approximation (RMSEA) due to the findings that suggest RMSEA is unreliable when measures employ ordinal response systems, resulting in consistent rejection of well-fitted models (Shi et al., 2020).

We used the multi-group CFA method to assess measurement invariance at the configural, metric, and scalar models. Based on Cheung and Rensvold (2002), CFI < 0.01 and SRMR < 0.030 indicate invariance between two nested models (e.g., configural model vs. metric model, and metric model vs. scalar model).

We evaluated the reliability and validity of the C-CIA via the *psych* package version 2.0.9 (Revelle, 2017). To explore the internal consistency of the C-CIA, we calculated Cronbach's α (≥ 0.70 suggests acceptable internal consistency reliability; Gadermann et al., 2012). To assess test-retest reliability, we calculated the intra-class correlation coefficient (ICC), which was calculated based on the two-way mixed-effects model (Koo & Li, 2016). According to the guideline of ICC interpretation, ICC values between 0.50 and 0.75 and greater than 0.75 are indicative of moderate and good reliability, respectively (Koo & Li, 2016).

Furthermore, we investigated the concurrent validity of the C-CIA, using total scores of C-CIA and theoretically correlated measures (e.g., eating disorder symptomatology, body dissatisfaction). To assess the known-group validity of the C-CIA, we used independent *t*-tests to differentiate individuals with high risks of EDs and those without, as determined by the EDE-QS total score above the cutoff of 15 (Prnjak et al., 2020). For interpreting correlation coefficients, values of 0.1 , 0.3 , and 0.5 were considered small, medium, and large, respectively (Cohen, 1992). For interpreting mean differences, we used Cohen's *d*, with values

of 0.2 , 0.5 , and 0.8 were considered small, medium, and large, respectively (Cohen, 1992).

3.5. Results

3.5.1. Confirmatory factor analysis and reliability

In junior high school students, the fit indices provided excellent support for the three-dimensional model of the C-CIA, with $\chi^2 = 949.53$ ($df = 101$, $p < .001$), CFI = 0.97 , TLI = 0.97 , SRMR = 0.04 . As shown in Table 1, the standardized factor loadings for the three-dimensional model ranged from 0.83 to 0.90 . Moreover, high intercorrelations (0.96 – 0.99) between the three factors indicated the existence of a general factor. In the literature, there are two approaches to examine the existence of a general factor (i.e., the higher-order model and the bifactor model; Markon, 2019). Even though the bifactor model generally shows better model fit than higher-order model (Cucina & Byle, 2017), it is still under debate on which model is superior to the other one (Murray & Johnson, 2013), and researchers also expressed concerns about applying bifactor models to psychopathology data (Bonifay et al., 2017). Since a previous study has applied a bifactor model to the CIA (Raykos et al., 2019), therefore we evaluated the bifactor model first. However, the model was not identified due to Heywood cases (e.g., negative variance). Thus, we then fitted a second-order model to the C-CIA, and results showed excellent model fit as well, with $\chi^2 = 949.53$ ($df = 101$, $p < .001$), CFI = 0.97 , TLI = 0.97 , SRMR = 0.04 . Internal consistency reliability, as indicated by the ordinal Cronbach's α , was 0.98 for the C-CIA. The ICC was 0.69 (an interval of six months).

In senior high school students, the fit indices also provided excellent support for the three-dimensional model of the C-CIA, with $\chi^2 = 1320.51$ ($df = 101$, $p < .001$), CFI = 0.97 , TLI = 0.97 , SRMR = 0.04 . As shown in Table 1, the standardized factor loadings for the three-dimensional model ranged from 0.79 to 0.90 . Then, we examined the second-order model, and the results showed the same excellent model fit as the three-dimensional model of the C-CIA. For the C-CIA, the ordinal Cronbach's α was 0.97 and the ICC was 0.76 (an interval of six months).

3.5.2. Sex invariance and mean differences

Next, based on the second-order factor structure, we examined the measurement invariance of the three-factor model of the C-CIA across sex. As described in Table 2, all indices supported configural, metric, and scalar invariance across sex in both junior and senior high school student samples. Given the support of a scalar invariance, we further examined the sex differences in the full scale of the C-CIA with independent *t*-tests. Our results showed no sex differences in C-CIA total scores between male and female junior high school students [(boys, $M = 10.24$, $SD = 10.72$; girls, $M = 10.36$, $SD = 10.00$), $t(721.62) = -0.15$, $p = .880$, $d = -0.01$] and between male and female senior high school students [(boys, $M = 11.55$, $SD = 9.73$; girls, $M = 10.84$, $SD = 9.15$), $t(1152.23) = 1.32$, $p = .188$, $d = 0.08$].

3.5.3. Construct validity

As shown in Table 3, in both junior and senior high school boys, psychosocial impairment was significantly and positively correlated with eating disorder symptomatology (medium to large effect sizes), body dissatisfaction (medium to large effect sizes), but significantly and negatively correlated with happiness (close to medium effect sizes).

3.5.4. Known-group validity

As presented in Table 4, in both junior and senior high school students, those with and without high risks of EDs were significantly different in the C-CIA total scores, with large effect sizes (Cohen's $d = 1.14$ and 1.37 for junior and senior school students, respectively).

4. Study 2

The objective of Study 2 was to examine the psychometric properties

Table 1

Standardized factor loadings of the three-dimensional structure of the C-CIA for four samples: Study 1, 2, and 3.

Items	Study 1: Junior high school students (n = 792)			Study 1: Senior high school students (n = 1324)			Study 2: Undergraduate students (n = 812)			Study 3: General adult male sample (n = 406)		
	PI	CI	SI	PI	CI	SI	PI	CI	SI	PI	CI	SI
2. ...made you more critical of yourself?	0.80			0.81			0.74			0.60		
8. ...made you upset?	0.88			0.87			0.89			0.82		
9. ...made you feel ashamed about yourself?	0.89			0.88			0.83			0.80		
11. ...made you feel guilty?	0.90			0.83			0.79			0.71		
14. ...made you feel a failure?	0.90			0.90			0.91			0.80		
16. ...made you worry?	0.90			0.86			0.86			0.81		
3. ...stopped you going out with others?		0.83			0.80			0.77			0.63	
7. ...interfered with meals with family or friends?		0.86			0.82			0.76			0.61	
10. ...made it difficult to eat out with others?		0.90			0.85			0.85			0.70	
12. ...interfered with your doing things you used to enjoy?		0.90			0.88			0.83			0.74	
15. ...interfered with your relationship with others?		0.87			0.87			0.89			0.77	
1. ...made it difficult to concentrate?			0.85			0.79			0.74			0.69
4. ...affected your performance at work (if applicable)?			0.87			0.83			0.82			0.73
5. ...made you forgetful?			0.84			0.81			0.73			0.60
6. ...affected your ability to make everyday decisions?			0.87			0.85			0.81			0.68
13. ...made you absent-minded?			0.88			0.87			0.90			0.79
Factor correlations												
PI	1.00			1.00			1.00			1.00		
CI	0.99***	1.00		0.95***	1.00		0.92***	1.00		0.82***	1.00	
SI	0.96***	0.96***	1.00	0.94***	0.95***	1.00	0.87***	0.89***	1.00	0.92***	0.78***	1.00

Notes: PI = personal impairment; CI = cognitive impairment; SI = social impairment.

*** $p < .001$.**Table 2**

Measurement invariance tests across sex for Study 1 and 2 based on the second-order three-factor structure.

	χ^2	df	CFI	TLI	SRMR	ΔCFI	$\Delta SRMR$
Junior high school students (n = 792)							
Boys (n = 372)	469.053***	101	0.978	0.974	0.036		
Girls (n = 420)	563.661***	101	0.972	0.966	0.040		
Configural Model	1032.724***	202	0.975	0.970	0.038		
Metric Model	815.803***	217	0.982	0.980	0.041	0.007	0.003
Scalar Model	1029.375***	245	0.976	0.977	0.038	-0.006	-0.003
Senior high school students (n = 1324)							
Boys (n = 585)	645.461***	101	0.975	0.970	0.044		
Girls (n = 739)	746.937***	101	0.972	0.967	0.045		
Configural Model	1387.219***	202	0.974	0.969	0.044		
Metric Model	1093.835***	217	0.981	0.978	0.047	0.007	0.003
Scalar Model	1377.811***	245	0.975	0.975	0.045	-0.006	-0.002
Undergraduate students (n = 812)							
Men (n = 295)	246.073***	101	0.981	0.977	0.051		
Women (n = 517)	413.796***	101	0.972	0.967	0.055		
Configural Model	650.973***	202	0.976	0.971	0.054		
Metric Model	595.434***	217	0.980	0.977	0.061	0.004	0.007
Scalar Model	606.661***	245	0.981	0.981	0.054	0.001	-0.007

*** $p < .001$.

and measurement invariance across sex for the C-CIA among undergraduate students (i.e., young adults).

5. Method

5.1. Participants, procedure, and measures

The protocol of the study was approved by the institutional research board of the Chinese University of Hong Kong, Shenzhen (No. EF20201024001). The dataset used in the current study was collected among undergraduate students from a university in Hunan Province. Specifically, two teachers introduced the project to undergraduate students during the weekly psychological health classes and invited them to participate. Those agreeing to participate completed the survey during class. More details of the procedures can be found in our published paper based on the male participants of the dataset (He, Murray, et al., 2021).

A total of 812 undergraduate students (295 males) were involved in the current study, and all participants provided informed consent. They were aged from 18 to 24 years with a mean of 18.88 years ($SD = 0.99$). The measures (i.e., the CIA, EDE-QS, EDI-BD, and K6) and data analyses methods from Study 1 were replicated in Study 2, except for the Single-Item Happiness Scale. In the current sample, the Cronbach's α of the EDE-QS, EDI-BD, and K6 was 0.88, 0.92, and 0.89, respectively. In addition, to evaluate the test-retest reliability of the C-CIA in undergraduate students, we newly recruited 237 undergraduate students (46.4% males) online via an online survey platform, Credamo. They were aged from 18 to 22 years with a mean aged of 20.60 years ($SD = 1.01$). The newly recruited undergraduate students filled in the survey twice in a two-week interval.

Table 3

Bivariate correlations between psychosocial impairment and other constructs in Study 1.

Junior high school students (<i>n</i> = 792)	1	2	3	4	5	6	7
1. Psychosocial impairment	–	0.49***	0.39***	0.52***	–0.28***	0.03	0.07
2. Eating disorder symptomatology	0.42***	–	0.54***	0.47***	–0.27***	0.04	0.30***
3. Body dissatisfaction	0.38***	0.55***	–	0.30***	–0.23***	0.03	0.44***
4. Psychological distress	0.40***	0.37***	0.23***	–	–0.48***	0.11	0.03
5. Happiness	–0.26***	–0.21***	–0.10	–0.42***	–	–0.12	0.04
6. Age	0.02	0.03	–0.05	0.06	–0.04	–	–0.15*
7. BMI z-score	0.10	0.33***	0.43***	0.06	0.09	–0.03	–
Boys <i>M</i>	10.24	6.33	27.55	6.36	4.02	13.18	–0.03
<i>SD</i>	10.72	7.68	11.37	5.22	1.09	0.49	1.14
Girls <i>M</i>	10.36	7.51	33.26	7.60	3.92	13.01	0.10
<i>SD</i>	10.00	6.58	10.77	5.59	1.11	0.52	1.03
Senior high school students (<i>n</i> = 1324)							
1. Psychosocial impairment	–	0.56***	0.38***	0.39***	–0.25***	0.02	0.20***
2. Eating disorder symptomatology	0.49***	–	0.56***	0.32***	–0.16***	–0.02	0.29***
3. Body dissatisfaction	0.36***	0.53***	–	0.25***	–0.20***	–0.07	0.49***
4. Psychological distress	0.41***	0.33***	0.24***	–	–0.36***	0.003	–0.03
5. Happiness	–0.20***	–0.13**	–0.21***	–0.33***	–	0.01	–0.02
6. Age	0.08	0.15***	0.11*	0.06	–0.06	–	–0.07
7. BMI z-score	0.11*	0.32***	0.46***	–0.004	0.05	0.02	–
Boys <i>M</i>	11.55	5.88	30.18	7.59	3.52	16.14	–0.05
<i>SD</i>	9.73	6.16	9.80	4.37	0.99	0.56	1.03
Girls <i>M</i>	10.84	7.80	35.88	7.86	3.78	15.99	–0.18
<i>SD</i>	9.15	5.94	9.19	4.17	0.92	0.51	0.86

Notes: In both junior and senior high school students' correlation matrices, girls' correlations are on the top diagonals, and boys' correlations are on the bottom diagonals.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 4

Differences in psychosocial impairment between individuals with and without risk of eating disorders in Study 1, 2, and 3.

Samples	Groups	Psychosocial impairment <i>M</i> (<i>SD</i>)	<i>t</i>	Cohen's <i>d</i>
Junior high school students (<i>n</i> = 756) ^a	Risks of EDs present (<i>n</i> = 121)	19.35 (12.62)	8.76***	1.14
	Risk of EDs absent (<i>n</i> = 635)	8.48 (8.87)		
Senior high school students (<i>n</i> = 1255) ^b	Risks of EDs present (<i>n</i> = 160)	21.34 (9.51)	15.60***	1.37
	Risk of EDs absent (<i>n</i> = 1095)	9.60 (8.43)		
Undergraduate students (<i>n</i> = 792) ^c	Risks of EDs present (<i>n</i> = 107)	13.97 (8.72)	8.75***	1.20
	Risk of EDs absent (<i>n</i> = 685)	6.22 (6.04)		
General adult men (<i>n</i> = 406)	Risks of EDs present (<i>n</i> = 107)	14.14 (8.16)	8.05***	1.07
	Risk of EDs absent (<i>n</i> = 299)	7.26 (5.66)		

^a 36 junior high school students missed the EDE-QS total scores.

^b 69 senior high school students missed the EDE-QS total scores.

^c 20 undergraduate students missed the EDE-QS total scores.

*** $p < .001$.

6. Results

6.1. Confirmatory factor analysis and reliability

Fit indices for the three-dimensional model of the C-CIA were excellent, with $\chi^2 = 518.79$ ($df = 101$, $p < .001$), CFI = 0.98, TLI = 0.97, SRMR = 0.05. Standardized factor loadings for the three-dimensional model ranged from 0.74 to 0.90, see Table 1. We also found excellent model fit for the second-order model. The ordinal Cronbach's α of the C-CIA was 0.96 and the ICC was 0.78 (an interval of two weeks).

6.2. Sex invariance and mean differences

We explored measurement invariance across sex using the second-order factor structure. As seen in Table 2, all indices suggested that configural, metric, and scalar invariance were supported across sex for undergraduate students. We found no differences in C-CIA total scores between men ($M = 7.33$, $SD = 7.28$) and women ($M = 7.40$, $SD = 6.93$), $t(794) = -0.13$, $p = .900$, $d = -0.01$.

6.3. Construct validity

As shown in Table 5, the C-CIA total scores were significantly and positively correlated with eating disorder symptomatology (medium to large effect sizes), body dissatisfaction (medium effect sizes), and psychological distress (large effect sizes).

6.4. Known-group validity

Scores on the C-CIA also differentiated participants in the high risk of ED group from those who were not with a large effect size (Cohen's $d = 1.20$), as shown in Table 4.

7. Study 3

The objective of Study 3 was to examine the psychometric properties

Table 5

Bivariate correlations between psychosocial impairment and other constructs in Study 2 and 3.

Undergraduate students (<i>n</i> = 812)	1	2	3	4	5	6
1. Psychosocial impairment	–	0.51***	0.36***	0.49***	–0.05	0.20***
2. Eating disorder symptomatology	0.42***	–	0.62***	0.37***	0.02	0.35***
3. Body dissatisfaction	0.26***	0.50***	–	0.24***	–0.003	0.53***
4. Psychological distress	0.62***	0.46***	0.28***	–	0.01	–0.01
5. Age	0.06	0.004	0.03	0.05	–	0.04
6. BMI	0.16**	0.39***	0.47***	0.09	0.10	–
Men <i>M</i>	7.33	6.24	31.40	4.67	18.92	22.13
<i>SD</i>	7.28	6.84	10.47	3.85	1.04	3.92
Women <i>M</i>	7.40	7.57	35.76	4.97	18.86	20.49
<i>SD</i>	6.93	5.87	10.29	3.95	0.96	2.95
General adult men (<i>n</i> = 406)	1	2	3	4	5	6
1. Psychosocial impairment	–					
2. Eating disorder symptomatology	0.58***	–				
3. Body dissatisfaction	0.45***	0.43***	–			
4. Psychological distress	0.66***	0.39***	0.33***	–		
5. Age	–0.10	–0.05	0.05	–0.12*	–	
6. BMI	0.12*	0.28***	0.47***	–0.02	0.33***	–
Men <i>M</i>	9.08	10.20	28.18	5.43	28.53	22.28
<i>SD</i>	7.08	6.57	10.00	3.49	5.56	2.80

Notes: In undergraduate students' correlation matrices, women's correlations are on the top diagonals, and men's correlations are on the bottom diagonals.

* $p < .05$.** $p < .01$.*** $p < .001$.

for the C-CIA among a male community sample.

8. Method

8.1. Participants, procedure, and measures

The current data is part of a project exploring eating behaviors and body image among Chinese adult men. The study protocol was approved by the institutional research board of the Chinese University of Hong Kong, Shenzhen (No. EF20201105002). The sample comprised 406 male adults (aged from 18 to 53 years), recruited via the online Chinese survey platform, Credamo, which is similar to Qualtrics Online Sample. Credamo recruits adult participants from the general adult population in China. More details of the procedures can be found in our published paper based on the same dataset (He, Murray, et al., 2021). The mean age of the sample was 28.53 years ($SD = 5.56$). We replicated measures and analyses described previously for Study 3. The Cronbach's α of the EDE-QS, EDI-BD, and K6 was 0.88, 0.92, and 0.82, respectively. In addition, to evaluate the test-retest reliability of the C-CIA in general male adults, we newly recruited 129 general male adults via Credamo. They were aged from 22 to 57 years with a mean aged of 33.64 years ($SD = 6.58$). The newly recruited participants filled out the survey twice in a two-week interval.

9. Results

9.1. Confirmatory factor analysis and reliability

We found excellent support for the three-dimensional model of the C-CIA, with $\chi^2 = 247.29$ ($df = 101$, $p < .001$), CFI = 0.97, TLI = 0.96, SRMR = 0.06. As shown in Table 1, the standardized factor loadings for the three-dimensional model ranged from 0.60 to 0.82. We also demonstrated excellent model fit for the second-order model. For the C-CIA, the ordinal Cronbach's α was 0.93, and the ICC of the C-CIA was 0.81 (an interval of two weeks).

9.2. Construct validity

Results showed a significant, positive correlation between C-CIA scores and related measures, as seen in Table 5. This study included

measures of eating disorder symptomatology (a large effect size), body dissatisfaction (a close to large effect size), and psychological distress (a large effect size).

9.3. Known-group validity

As shown in Table 4, male adults with and without high risks of EDs were significantly different in the CIA total scores, with a large effect size (Cohen's $d = 1.07$).

10. Study 4

The objective of Study 4 was to examine measurement invariance across the four age groups for the C-CIA [i.e., junior high school students ($M_{age} = 13.09$ years), senior high school students ($M_{age} = 16.06$ years), undergraduate students ($M_{age} = 18.88$ years), and men in a general population-based sample ($M_{age} = 28.53$ years)]. Given that Study 3 did not include women, we included sex as a second grouping variable in data analyses.

10.1. Participants and procedure

This dataset comprises all participants from Study 1, 2, and 3. The data analysis for examining measurement invariance was described in Study 1.

11. Results

As shown in Table 6, all indices suggested support for configural, metric, and scalar invariance across age groups in both male and female groups, supporting the comparisons using the C-CIA across age groups.

As described in Table 7, for males, a significant overall difference was found, with $F(3, 1352.15) = 15.89$ ($p < .001$). Follow-up post-hoc tests with Bonferroni corrections (i.e., the corrected $\alpha = 0.008$) showed that senior high school boys ($M = 11.55$, $SD = 9.73$) had significantly higher levels of psychosocial impairment than undergraduate men ($M = 7.33$, $SD = 7.28$; $d = 0.49$, $p < .001$) and general male adults ($M = 9.08$, $SD = 7.08$; $d = 0.29$, $p < .001$); however, there was no difference between senior school boys and junior high school boys ($d = 0.13$, $p = .252$).

Table 6

Measurement invariance tests by age for males and females in Study 4.

	χ^2	df	CFI	TLI	SRMR	Δ CFI	Δ SRMR
Males (n = 1658)	1103.335***	101	0.976	0.972	0.036		
Configural Model	1542.119***	404	0.979	0.975	0.047		
Metric Model	1260.161***	449	0.985	0.984	0.055	0.006	0.008
Scalar Model	1623.448***	553	0.980	0.982	0.048	−0.005	−0.007
Females (n = 1676)	1444.875***	101	0.972	0.967	0.039		
Configural Model	1690.433***	303	0.973	0.968	0.047		
Metric Model	1383.319***	333	0.979	0.978	0.055	0.006	0.008
Scalar Model	1613.933***	389	0.976	0.978	0.047	−0.003	−0.008

*** $p < .001$.**Table 7**

Age differences in psychosocial impairment by sex.

	Junior high school students (n = 792)	Senior high school students (n = 1324)	Undergraduate students (n = 812)	General adult men (n = 406)	F	df_{between}	df_{within}
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)			
Males	10.24 (10.72) a, b	11.55 (9.73) b	7.33 (7.28) a	9.08 (7.08) a	15.89***	3	1352.15
Females	10.36 (10.00) a	10.84 (9.15) a	7.40 (6.93) b	–	24.44***	2	1235.82

Notes: Subscripts (a, b, c, d) that differ represent significant pairwise differences between the age groups under Bonferroni correction.

*** $p < .001$.

For females, a significant overall difference was also found, with $F(2, 1235.82) = 24.44$ ($p < .001$). Follow-up post-hoc tests with Bonferroni corrections (i.e., the corrected $\alpha = 0.017$) showed that senior high school girls ($M = 10.84$, $SD = 9.15$) had significantly higher levels of psychosocial impairment than undergraduate women ($M = 7.40$, $SD = 6.93$; $d = 0.42$, $p < .001$); but there was no difference between senior high school girls and junior high school girls ($d = 0.05$, $p = .703$).

12. Discussion

The current study aimed to translate the CIA into Chinese (Mandarin) and validated the Chinese version (i.e., C-CIA) among Chinese adolescents, young adults, and adult men. Our findings showed that the C-CIA had good psychometric properties (including excellent internal consistency, moderate to good test-retest reliability, and strong construct validity) across males and females in all samples. The C-CIA was also found to be sex invariant (males vs. females) and age invariant (adolescents vs. adults). In addition, no significant sex differences were found in the total scores of the C-CIA, but there were significant age differences in the total scores of the C-CIA.

Overall, our findings replicated much of the previous literature on the CIA within a Chinese context. Our results supported the three-factor structure of the C-CIA (Bohn & Fairburn, 2008) among Chinese nonclinical samples of adolescents, young adults, and adult men. This replicates prior studies of the CIA, indicating the CIA possesses a robust factor structure across different cultures (e.g., Martín et al., 2015), including China. We also found that participants at a high risk of EDs reported significantly higher C-CIA total scores than those not found to be at-risk of EDs, providing preliminary evidence of the clinical utility of the C-CIA in a Chinese context. This is consistent with previous studies indicating large differences in the CIA total scores between individuals with or without an ED (Raykos et al., 2019; Schluter et al., 2016; Vanucci et al., 2012; Welch et al., 2011).

Further, while our results supported both sex and age invariance across groups, we did find age differences with adolescents reporting higher C-CIA total scores than adult males and females. These findings align with prior research reporting that ED symptomatology had a greater impact on the psychosocial functioning of younger individuals (Mitchison et al., 2018; Rø et al., 2012). Given these results, it is imperative to design ED interventions targeting Chinese adolescents, especially considering the limited research from China on interventions targeting disordered eating and/or body image disturbances (Luo et al.,

2021).

Contrary to previous studies conducted in Western countries (Dahlgren et al., 2017; Mehak & Racine, 2019), where males typically demonstrate lower CIA total scores than females, we did not detect sex differences among C-CIA scores in either adolescent or young adult samples. This may suggest cultural differences (Western countries vs. China) in psychosocial impairment secondary to eating disorder symptomatology, especially considering that there are cultural differences in eating disorder symptomatology between Chinese and their Western counterparts (Jackson & Chen, 2007). This should be confirmed in future studies as well as the cross-cultural measurement invariance and mean differences of the CIA (e.g., He, Zickgraf, et al., 2021).

The presented studies are not without limitations. First, the adolescent and young adult samples were identified by convenience sampling methods; thus, caution should be taken in generalizing these findings to the general Chinese adolescent and young adult populations. Second, we did not recruit adult women from the general population, so our findings may not be generalizable to adult women from the general population, especially to those over 24 years old. Third, the psychometric properties of the C-CIA were not examined in Chinese patients with EDs; thus, validation studies of the C-CIA in patients with EDs should be conducted to provide support to the use of the C-CIA in clinical settings. Fourth, considering that a clinical cutoff score of 16 for the CIA was proposed to determine EDs case status (Bohn & Fairburn, 2008), this cutoff score may need further validation to be used in the Chinese context with both clinical and nonclinical samples. Finally, even though age invariance was met for the C-CIA, the sampling differences to obtaining the samples (e.g., online survey in the general adult male sample vs. paper-and-pencil surveys in junior and senior high school students and undergraduate students) may contribute to the significant age differences.

In sum, the C-CIA demonstrated good psychometric properties in Chinese samples with different sexes and ages, including male and female adolescents and adults. Although future studies are required in clinical populations, the C-CIA effectively discriminated between those at-risk for ED across age groups and scores were strongly related to ED psychopathology. Thus, the C-CIA may be a valuable tool in future research with nonclinical Chinese populations for assessing psychosocial impairment secondary to EDs.

CRedit authorship contribution statement

JH designed the study, analyzed the data and wrote the manuscript.

ABM helped review and revise the manuscript. MC helped review and revise the manuscript. SC helped revise the manuscript. GC helped review and revise the manuscript. All authors approved the final version of the manuscript for submission.

Funding

The study was supported by the Shenzhen Education Science Project to Jinbo He (Grant Number: ybfz20058).

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the research committee of the Chinese University of Hong Kong, Shenzhen, and Hengyang Normal University.

Informed consent

Informed consent was obtained from all the surveyed participants.

Data availability

The datasets and R scripts are available from the link: <https://osf.io/we675/>

Declaration of competing interest

No conflict of interest declared.

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