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### **Evaluation of the Factor Structure of the Adolescent Stress Questionnaire in Chinese Adolescents**

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#### Abstract

This study evaluated the psychometric properties of the Chinese version of Adolescent Stress Questionnaire (ASQ-CN) in a sample of Chinese middle school students (N= 420; 52.14% boys and 47.86% girls). Iterated principal factor analysis and multiple-group principal components cluster analysis supported a six-factor model with 42 items out of 58 items in the ASQ-CN. The internal consistency was from .82 to .90. Girls reported lower stress levels in one subscale, Stress of romantic relationship, whereas no gender differences were found in the other five subscales. Compared with other studies of the ASQ in Westernized countries, the ASQ-CN showed a distinct factor structure that may be explained by cross-cultural differences. Scales constructed from factor analysis related negatively to measures of mindfulness and positively to a measure of behavioral problems, suggesting that they were valid for Chinese adolescent stress. The study did not support a higher order construct of the ASQ-CN. Altogether, our findings suggest that the ASQ-CN is adequate for assessing stressors in Chinese adolescents.

#### Keywords

Adolescent; stress; factor structure; China

#### Introduction

Adolescence is a period of drastic transition in human development during which numerous biological, psychological, cognitive, and social changes occur (Colten, 2017; Grant et al., 2006; Hamilton, Stange, Abramson, & Alloy, 2015; Hankin, Badanes, Abela, & Watamura, 2010; Hankin et al., 2015). These changes can be overwhelming, since adolescents, and especially younger adolescents, have fewer coping skills compared with older adolescents or adults (Seiffge-Krenke, 2013; Zimmer-Gembeck & Skinner, 2011). These changes may become stressors to which adolescents have to adapt (Jackson & Goossens, 2006; Seiffge-Krenke, Aunola, & Nurmi, 2009; Stroud et al., 2009). Cumulative and simultaneous

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occurrences of stressors can constitute potential threats to the well-being and healthy development of children and adolescents (Colten, 2017; Eiland & Romeo, 2013; Grant et al., 2003). Adolescent stress has been related to not only health-risk behaviors, such as consuming alcohol, smoking and abusing other substances, and maintaining poor eating habits (Garcia, 2010; Jaaskelainen et al., 2014; Low et al., 2012; King, Molina, & Chassin, 2009; Rew, Johnson, & Young, 2014) but also depression (Charbonneau, Mezulis, & Hyde, 2009; Liu & Alloy, 2010; Moksnes, Byrne, Mazanov, & Espnes, 2010; Murray, Byrne, & Rieger, 2011), anxiety (Anyan & Hjemdal, 2016; Beiter et al., 2015), and suicidal behaviors (Hewitt, Caelian, Chen, & Flett, 2014; Mathew & Nanoo, 2013). Therefore, it is important to assess and understand adolescent stress using reliable and valid measurements to promote adolescent health.

The methodology of measuring stress in adolescents varies from study to study (Grant, Compas, Thurm, McMahon, & Gipson, 2004; Mullis, Youngs, Mullis, & Rathge, 1993). Major methodologies include interviews, cortisol level testing, and self-report inventories (Rew et al., 2014). However, interview methods are both time consuming and labor intensive (Byrne, Davenport, & Mazanov, 2007), and cortisol level testing only provides very limited information on sources of adolescent stressors outside of laboratory settings. Self-report inventories are more practical for large samples and are easily administered to measure levels and sources of stress, which serves as an important first step toward prevention of psychopathology (Doom & Gunnar, 2013; Kessler, Price, & Wortman, 1985; Sontag & Graber, 2010; Suldo & Huebner, 2004).

The Adolescent Stress Questionnaire (ASQ) (Byrne et al., 2007) is the most recent and widely used self-report questionnaire specifically developed to understand the nature of adolescent stressors and investigate a broad span of stressors in adolescents. It employs a standard focus group methodology to avoid researchers' subjective opinions of what is regarded as stressors for adolescents, as most checklists impose (Compas & Reeslund, 2009; Moksnes & Espnes, 2011). Since the initial publication of the ASQ, it has been translated and evaluated in various countries, including Norway, Greece, the United Kingdom, and other European countries (Darviri et al., 2014; De Vriendt et al., 2011; Mckay, Percy, & Byrne, 2014; Moksnes et al., 2010). These studies have shown that the factor structure of the ASQ is similar across Australia (Byrne et al., 2007) and European countries like Greece and the United Kingdom (De Vriendt et al., 2011; Mckay et al., 2014), whereas the factor structure differs from that in Norway (Moksnes et al., 2010). Despite the variation, the researchers argued that the overall factor structures in all Western samples resembled one another and that the structure differences may be negligible. They regarded the ASQ as a reliable and valid instrument to assess adolescent stressors from various sources.

Similar to findings in the Western countries, stress has negative effects on Chinese adolescents. For example, adolescent stress in China has been found to be related to low academic achievement (Liu & Lu, 2011), depression (Auerbach, Eberhart, & Abela, 2010; Sun, Tao, Hao, & Wan, 2010), anxiety (Young & Dietrich, 2015), smoking and alcohol use (Liu, 2003; Unger et al., 2001), Internet addiction (Tang et al., 2014), unhealthy eating behaviors (Hou et al., 2013), and suicidal behaviors (Liu & Tein, 2005; Zhang, Wang, Xia, Liu, & Jung, 2012). Therefore, there is a need for a valid and reliable tool to assess

adolescent stress in China as well. Most of the questionnaires that assess adolescent stress in the existing Chinese literature focus mainly on academic stress (Leung, Yeung, & Wong, 2010; Sun, Dunne, Hou, & Xu, 2011; Sun, Dunne, Hou, & Xu, 2013; Tan & Yates, 2011) and may overlook other sources of daily life stress. Two Chinese studies (Liu & Lu, 2011; Sun et al., 2011) have purposively selected a subset of items from the ASQ. Liu and Lu (2011) found acceptable psychometric properties of the Chinese version of 26 items from the ASQ, but this version failed to demonstrate the validity and reliability of the full-length ASQ in their study. Sun et al. (2011) used the ASQ as part of the item pool to develop a measure of stressful life events and did not focus on examining the psychometric properties of the full-length ASQ either. Therefore, this study which assesses stress in a Chinese adolescent sample not only provides evidence for the usefulness of the ASQ-CN but may also disclose a greater variety of stressors presented to Chinese adolescents besides academic ones.

For the aforementioned reasons, this study aims to test the applicability of the *ASQ* in Chinese adolescents by (a) examining the factor structure of the *ASQ-CN* via the exploratory factor analysis technique and comparing the results with those found in previous studies of the *ASQ* in Western cultures; (b) evaluating the internal consistency of the *ASQ-CN*; (c) examining its gender generalizability and gender differences in levels of stress, as a wide range of evidence indicates that levels of stress vary significantly between boys and girls (Byrne et al., 2007; Darviri et al., 2014; De Vriendt et al., 2011; Jensen, Sveback, & Gotestam, 2004); and (d) testing the hypothesized higher order structures by imposing a second-order model and two confirmatory bifactor models on the basis of the exploratory factor structure.

#### Methods

#### Study design and subjects

The present study was part of the China Jintan Child Cohort study funded by the National Institute of Environmental Health Sciences (Liu et al., 2010, 2015; Liu, McCauley, et al., 2011). The China Jintan Child Cohort study is an ongoing longitudinal study that initially recruited 1656 Chinese preschoolers in Jintan City, China, using a multiple-stage sampling method and has completed three waves of data collection since 2004. A stratified sampling process was set up first to select four preschools across three locations: rural, suburban, and urban. Then a cluster sampling strategy was employed to include students within each selected preschool. During the first wave of data collection in 2004–2007, the parents and teachers of 1385 children aged three to six years responded to the cohort study with a response rate of 83.6% (Liu et al., 2015). When the children were in their last month of sixth grade in 2011–2013, we invited them to participate in the second wave study and 1110 children responded to the cohort study. Data collection of the third wave (Wave III) is ongoing. For the current study, we used a subsample of 422 children who were administered the Chinese ASQ (ASQ-CN) and other measures of mindfulness and behavioral problems in Wave III. Two subjects did not complete any item of the ASQ-CN and were removed from the sample. The study ultimately employed a sample of N = 420 (52.14% boys and 47.86%) girls) with a mean age of 14.78 years (SD = .59) for boys and 14.71 years (SD = .53) for

girls. The age range was 13 to 16 years. Boys and girls were not significantly different in age (t=1.78, p=.08). Both signed consent forms from each participant's mother and verbal consent from participants were obtained during the data collection. Institutional review board approval was obtained from the University of Pennsylvania and the Ethical Committee for Research at Jintan Hospital in China.

#### Instrument translation

The ASQ was developed by Byrne et al. (2007) with 58 items. Using principal component analysis, the ASQ defines a 10-factor model with oblique factor rotation that covers the adolescent stressor sources and their extents broadly. Each item was rated on a 5-point Likert scale from 1 = not at all stressful to 5 = very stressful. Upon being granted permission from Byrne to use the ASQ in the present study, the principal investigator of the China Jintan Child Cohort study, who is fluent in English and Chinese, led a team that translated the ASQ into Chinese which included a psychologist and a postgraduate student in education. We conducted the standard forward- and back-translation procedure based on the standard translation procedure suggested by Brislin (1986) and our previous experiences in translating instruments (Liu, Li, & Fang, 2011; Liu, Qiao, Dong, & Raine, 2018). As it is illegal for adolescents under 16 years to work for any employers in China, and parents generally have absolute control over money, three original items related to financial stress were removed (i.e., item 10: "employers expecting too much from you," item 22: "pressure to make money," and item 47: "having to take on new financial responsibilities with growing older"). Instead, we added three new items that entailed Chinese-characterized academic and family-related stressors for Chinese adolescents (i.e., item 10: "relatives other than your parents expecting too much from you," item 22: "taking extra classes outside school hours," and item 47: "admission by a good high school"). Then, a monolingual reviewer examined this Chinese version for incomprehensible or ambiguous words. We then back-translated this first Chinese version into English. This back-translated English version was compared with the original version to assess discrepancies and to determine whether the inconsistencies could be attributed to the Chinese forward-translation or the English back-translation. Errors in the forward- or back-translation processes required repeating the process again and, if necessary, taking the measure through a second back-translation.

#### Other constructs

**Mindfulness.**—This was chosen as a validating construct since several meta-analysis studies (Chiesa & Serretti, 2009; Grossman, Niemann, Schmidt, & Walach, 2004; Khoury et al., 2013; Khoury, Sharma, Rush, & Fournier, 2015) concluded that mindfulness-based therapy has been found to be effective in reducing stress and that mindfulness is strongly related to stress. It was measured by the Five Facet Mindfulness Questionnaire short form (*FFMQ-SF*: Bohlmeijer, Ten Klooster, Fledderus, Veehof, & Baer, 2011) which has 24 items on a 5-point Likert scale ranging from 1 (*never or very rarely true*) to 5 (*very often or always true*) and the Child and Adolescent Mindfulness Measure (*CAMM*: Greco, Baer, & Smith, 2011) with 10 items on a 5-point Likert scale (0 = *never*, 4 = *always*). The current study current used the Chinese version of both instruments which have been validated in Chinese adolescents (Deng, Liu, Rodriguez, & Xia, 2011; Hou, Wong, Lo, Mak, & Ma, 2014; Zhou,

Liu, Niu, Sun, & Fan, 2017). The total mindfulness scores of each instrument were utilized in this study.

**Behavioral problems.**—This was chosen as another validating construct since stress too is found to be associated with behavioral problems in children and adolescents (Hanson et al., 2015; McKnight, Huebner, & Suldo, 2002; Windle, 1992). It was measured by the Youth Self-Report (*YSR*: Achenbach & Rescorla, 2001) which has been validated in China as well (Ivanova et al., 2007; Leung et al., 2006). The *YSR* has 116 items on a 3-point Likert scale ranging from 0 (*not true*) to 2 (*very true or often true*) which assesses internalizing (i.e., anxiety, depression, and overcontrolled) and externalizing (i.e., aggressive, hyperactivity, noncompliant, and undercontrolled) behaviors.

#### Missing data and imputation

Out of 420 subjects, 394 subjects responded to the 58 items completely. The subjects with missing responses constituted 6.2% of the sample. Multiple imputations with the Markov-Chain Monte Carlo method were performed to produce imputed data with a monotone missing pattern. The auxiliary variables included school, grade, class, and gender. Regression imputation was then implemented on the imputed data sets with monotone missing patterns. The relative efficiency for each imputed item variable was above 99.5%, indicating a successful imputation. Combining all imputed data sets finally generated a pooled data set to be analyzed.

#### Item analysis and data preparation

According to Tabachnick and Fidell (2007), data-screening analysis was conducted to detect items with restricted variance or highly skewed distribution. The mean of each item ranged from 1.65 to 2.83, with standard deviations from .97 to 1.29. No item with restricted variance was discerned. The amount of skewness ranged from .23 to 1.55 (M= .87, SD= . 35), and kurtosis was from -.96 to 1.99 (M= .24, SD= .76), suggesting that there was no outlier with extreme nonnormal distribution. Item analyses included item-total correlation, <sup>1</sup> conditional alpha for the deletion of each item (Cronbach, 1990), and coefficient alpha for the overall sum of unit-weighted item scores (Wainer, 1976). The goal of the analyses was to check no item operating to suppress internal consistency and to produce respective internal consistency .70 and acceptable variability (.20 item-total r .80, see Allen & Yen, 2001; Henrysson, 1971, on item analysis).

A polychoric matrix was used to conduct exploratory factor analysis (EFA) because Pearson correlation matrices on categorical data may produce spurious factors in the conventional EFA (Bernstein & Teng, 1989; McDonald & Ahlawat, 1974; Mislevy, 1986; Mooijaart, 1983; Muthen, 1988; Waller, 2001) and underestimate the strength of relationships between ordinal items (Olsson, 1979). In addition, the polytomous full-information methods, which are very useful for ordinal data, are not currently available through commercial programs and remain proprietary (McDermott et al., 2011; McDermott, Watkins, Rovine, & Rikoon, 2013). Fortunately, Waller (2001) suggested an iterative factoring of a smoothed polychoric

<sup>&</sup>lt;sup>1</sup>·Item-total correlation is calculated as polyserial correlation.

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matrix. Hence, Waller's MicroFACT software was used to obtain the smoothed polychoric matrix of the 58 items from the pooled data set.

#### **Exploratory factor analysis**

The obtained polychoric correlation matrix was submitted to both exploratory orthogonal and oblique common factor analyses that were suggested by Goldberg and Velicer (2006) and included multiple correlations squared as the initial communality estimates in the iterative principal factoring process to obtain the factor structure of the ASO-CN using SAS Software Version 9.4 (SAS Institute Inc, Cary, NC). The common factor analysis, rather than the principal component analysis, was used because it is a more accurate procedure in generating unbiased loadings with smaller standard error than the principal component analysis (Snook & Gorsuch, 1989). In addition, it is a true factor analysis that serves to identify latent constructs that underlie a battery of measured variables (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Kline, 2014). The correlation matrix was assessed using Bartlett's chi-square criteria (Geweke & Singleton, 1980), which rejected the likelihood of an identity matrix (p < .0001) and indicated that a maximum of eight dimensions might be extracted. To further determine the number of factors, Montanelli and Humphreys's (1976) parallel analyses provided the upper bound limit of 34 factors. The matrix was also submitted for minimum average partialling (Velicer, 1976) which suggested seven components for retention. As minimum average partialling tended to underextract (Ledesma & Valero-Mora, 2007) and parallel analysis tended to overextract (Hayton, Allen, & Scarpello, 2004; O'connor, 2000), all one- through eight-factor models were assessed. The one-through eight-factor structure models were evaluated, and the best model was chosen if it met the following rules: (a) satisfies Cattel's scree test; (b) retains three or more items with salient loadings, where loadings . .40 are considered salient; (c) yields reasonable internal consistency for unit-weighted salient items(i.e., .70); (d) approximates simple structure with highest hyperplane count (Gorsuch, 2008); and (e) makes theoretical sense in terms of parsimonious coverage (mutually exclusive assignment of items to factors, maximum number of items retained) of the data and the compatibility with research in the field (Fabrigar et al., 1999).

#### **Confirmatory factor analysis**

After selecting the best EFA model, we conducted an oblique multiple-group principal components cluster analysis (Anderberg, 2014; Harman, 1976) based on the best EFA model. We allowed items to migrate iteratively to alternative scales if it better explained item variance.

#### Generalizability to subsamples

To test the hypothesis that the factor structure resolved for the composite sample was generalizable to the subgroups as boys and girls, we repeated the ideal factoring solution of the composite sample for each subsample. We compared the solution derived for each subsample with that for the composite sample using coefficients of congruence that were based on all the obtained loadings (Guadagnoli & Velicer, 1991), following the analysis procedure described in Fantuzzo, McDermott, Manz, Hampton, and Burdick (1996) and McDermott et al. (2000). In addition, measurement invariance analyses were conducted

using Mplus (Muthén and Muthén, 2010) to investigate factor structure similarity across gender.

#### Results

One- through eight-factor models were tested against the stated criteria, and the six-factor promax-rotated (k = 4) model met all criteria and was selected as the best EFA model. In this six-factor model, salience was found for 48 out of the original 58 items. Three items out of the 48 (i.e., item 34, item 39, and item 54) were loaded on two factors simultaneously and, therefore, were removed from their respective factors (Comrey, 1998). Confirmatory analysis of the six-factor model with the remaining 45 items showed that three items (i.e., item 28, item 32, and item 37) migrated to their alternative factors and thus were removed, which did not significantly suppress the internal consistency of the respective factor. As a result, the final model consisted of a total of 42 surviving items that were loaded on the six factors, namely, "stress of romantic relationships," "stress of getting along with others," "stress of academic future uncertainty," "stress of school/leisure conflict," "stress of daily life," and "stress of parental authority and emerging autonomy" (see Table 1). A comparison of the *ASQ-CN* and the Western versions of the *ASQ* is provided in Supplemental Table S1.

Table 2 displays moderate inter-factor correlations, which suggests that there might exist a general construct of generic stress or a second-order factor as an umbrella factor of the six first-order factors. However, further analyses showed that both the bifactor model of the original 58 items (*CFI*=.868, *RMSEA* = .070 with 90% *CL* = [.067, .072]) and the bifactor model of the 45 items from the best EFA model (*CFI*=.887, *RMSEA* = .095 with 90% *CL* = [.092, .098]) failed to achieve acceptable model fit (Gibbons et al., 2007; Hu & Bentler, 1999). See Supplemental Table S2. In addition, the second-order factor model failed to retain a significant amount of variance that was reliable and unique (Supplement Table S3). Thus, the hypothesis of a higher order construct is not supported. Results of three measurement invariance models and their comparisons are presented in Table 3. For the six-factor model, configural invariance was attained because the overall model fit index *CFI* and the *RMSEA* range were acceptable. Metric model and Scalar model were rejected because the model comparisons were significant at  $\alpha = .05$  level.

The coefficients of congruence and internal consistency of the six-factor model in each gender subgroup indicated high to moderately high generalizability for the six-factor model structure to boys and girls, respectively. A comparison of the gender differences of the unit-weighted factor scores showed that girls scored significantly lower than boys on the factor of stress of romantic relationship, and there was no gender difference on other factor scores (see Table 4).

#### **Concurrent criterion validity**

Three criterion measures (*FFMQ-SF, CAMM*, and *YSR*) were employed to test for concurrent criterion validity for the *ASQ-CN*. Three measures correlated significantly and moderately with each other and in the expected direction with one another. All six dimensions of adolescent stress correlated significantly and in the expected directions with

these criterion measures (positively with behavioral problems and negatively with mindfulness); strengths of associations can be seen in Table 5.

#### Discussion

To our knowledge, this is the first study to report the psychometric properties of the Chinese version of the *ASQ* in a sample of Chinese adolescents. The results of the EFA and CFA showed that the factor structure consisted of 42 items with salient loadings and six moderately correlated factors, which explained 59.6% of the item variance. The Chinese factor structure also demonstrated subscales with high internal consistency (Cronbach's alpha went from .82 to .90), and the internal consistency of subscales are generally higher than those of the previous *ASQ* studies in European countries (Cronbach's alpha ranges from .57 to .92; Byrne et al., 2007; De Vriendt et al., 2011; Moksnes et al., 2010).

We found that the *ASQ-CN* had six factors of 42 items, which were different from results of the ASQ in Westernized countries (i.e., Australia, Norway, Greece, and other European countries) in terms of number of factors and item loadings on the factors. Such differences may be due to the unique adolescent development embedded within Chinese culture (Lam, 1997; Yang, 1981, 1986).

#### Factor description and comparison

Most of the items loaded on the "stress of romantic relationships" factor in the *ASQ-CN* were also loaded on the same factor in Western versions of the *ASQ*. Nevertheless, some items that contributed to other factors in Western versions of the *ASQ* were loaded on this factor as well. Specifically, item 41, "teachers hassling you about the way you look" which was loaded on factor "stress of teacher interaction" in Western versions, contributed to the "stress of romantic relationship" factor in this study. This may be because young people's conception of a good romantic partner is based on external qualities such as looks (Furman, Brown, & Feiring, 1999). In China, teenagers spend most of their daytime interacting with their peers and teachers simultaneously at school. As a result, hassle from teachers about teenagers' appearance could have more impact on their romantic relationship in China than in those Westernized countries.

It is worth noting that, despite that "stress of romantic relationship" in the *ASQ-CN* and in Western versions of the *ASQ* share most of the items, the nature of the stress of romantic relationships among Chinese adolescents may be different from that of Western adolescents. Unlike many Western societies, which consider romantic relationships among adolescents as normal experiences of human development, the Chinese generally agree that adolescent romantic relationships have adverse effects on adolescents' academic achievements and induce deviant behavioral outcomes, like teenage sexuality and pregnancy (Shen, 2015). Schools and parents generally prohibit romantic relationships among adolescents, and those in romantic relationships could face warnings and surveillance from teachers and parents if the relationship is not discontinued. Consequently, romantic relationships are extremely stressful for adolescents in the Chinese context.

The second factor was labeled as "stress of getting along with others" because the composited items involve interpersonal relationships with family members, teachers, and peers. Confucianism in China aims to achieve a harmonious society, and the core of Chinese values is manifested as collectivism, where attitudes and behaviors are associated with a high concern for others (Chiu, 1990). Interpersonal conflicts or rejection may be perceived as undesirable, especially when disagreement occurs between adolescents and adults. Adolescents may feel lack of respect and trust and misunderstanding during the process of dodging conflicts (Liu, Tein, & Zhao, 2004), which may, in turn, cause stress, anxiety, and depression.

In contrast to the factor of "stress of future uncertainty" in Western versions of the *ASQ*, this factor emerged as the third factor in the *ASQ-CN* is more specific to academic future uncertainty. Academic achievement stands out from the broad stress of future uncertainty because it is of absolute importance in the lives of Chinese adolescents, as it is regarded as a filial duty and a source of pride for the family (Wong et al., 2005). Academic success is also viewed as a route to enter prestigious high schools and colleges, acquire a decent job, and, eventually, make a good living (Lau, Nicholls, Thorkildsen, & Patashnick, 2000). Chinese teachers and parents generally expect students to achieve good grades (e.g., item 6, item 10, and item 46), which can be a major stressor for Chinese adolescents. In addition, Chinese adolescents may feel stressed when they try to live up to academic expectations from teachers and parents, regardless of whether their present academic performance is good (e.g., item 47) or poor (e.g., item 9, item 12, and item 25).

The construct of the fourth factor, "stress of school/ leisure conflicts," is similar to that of Western versions of the *ASQ*, except that the *ASQ-CN* contains extra items: item 3, item 5, and item 14. These three items loaded on the factor "stress of school attendance" or "stress of school performance" in Western versions of the *ASQ*. This may be because Chinese students spend considerably more amount of time in school and on homework (e.g., item 3 and item 14), especially when they have difficulty understanding school materials (i.e., item 5), than Western students (Tan & Yates, 2011), which leaves them with less time for leisure activities. From this prospective, Chinese adolescents may feel stressed when they compromise their leisure time for studying.

The fifth factor "stress of daily life" characterizes sources of stress from daily lives including school life and home life, since they are bonded very closely for Chinese adolescents. These stressors included attending school regularly on weekdays (i.e., item 33), getting allowance from parents (i.e., item 38 and item 51) since they are not allowed to work independently, dressing properly in school (i.e., item 36), and following school rules to avoid any warnings or punishments (i.e., item 42 and item 57).

The last factor was labeled as "stress of parental authority and emerging autonomy," of which the three dominant items with the highest salient loadings were the elements of the factor "stress of home life" in Western versions of the *ASQ*. In the *ASQ-CN*, the items may reflect parent–child relationships more specifically, especially parenting styles. Chinese parents may adopt more authoritarian parenting styles, since the traditional Chinese family has a hierarchical structure with clearly defined roles and responsibilities (i.e., item 11),

deference to parental authority (i.e., item 13), respect for fathers, and children's filial piety to the family (Chao, 1995; Pye, 1992; Sue & Sue, 2012), which may be sources of stress for Chinese adolescents. In addition, adolescence is a critical period when adolescents develop desires to be independent and autonomous (Yau, Smetana, & Metzger, 2009), although Chinese parents may still experience authoritarian parenting styles, which may produce more conflicts between parents and adolescents that could become a source of stress (i.e., item 1, item 2, item 18, and item 21; Lam, 1997; Xu et al., 2005). Moreover, conflicts provide a context in which adolescents (Yau & Smetana, 1996). It should be noted that item 8 belongs to "stress of peer pressure" in Western versions of the *ASQ* but loads on "stress of parental authority and emerging autonomy" in the *ASQ-CN*. This may be because peer pressure during early to mid-adolescence results from individuation in the development of behavioral autonomy (Steinberg, 2014). Chinese adolescents may particularly struggle between fitting into groups and being individualized.

#### Higher order construct

Given the moderate inter-factor correlation, two types of higher order models (i.e., the bifactor model and the second-order model) were examined. The bifactor model assumes that the general factor and group factors are orthogonal to each other, while the second-order model allows correlations between the higher order factors and lower order factors. The results illustrated that neither of the two types of models was acceptable, which indicated that higher order constructs may not exist. The Australian *ASQ* and the Norwegian *ASQ* did not investigate higher order constructs, although the Norwegian *ASQ* also presented moderate inter-factor correlations which may suggest a potential higher order construct. The European *ASQ* reported moderate to high inter-factor correlations and confirmed a second-order construct. However, the results of the European *ASQ* should be interpreted with caution. First, in the European *ASQ*, one component's Cronbach alpha was as low as .57 with only three items, which may suggest over-extraction of factors in the procedure of confirmatory factor analysis. Second, the researchers in the European *ASQ* study failed to justify the confirmatory factor analysis of the second-order construct based on theories or empirical evidence. Instead, their study was statistics driven and, thus, questionable.

#### Generalizability and gender difference

The configural invariance result provided evidence of identical factor structure across gender, and the results of significance in model comparisons showed lack of evidence of equal factor loadings or intercepts across gender. From the perspective of congruence coefficients, however, the factor loadings for each gender subgroup did not vary much from those obtained from the composite sample.

Further comparisons of gender differences of each factor score showed that girls reported lower level of "stress of romantic relationships" than boys, and no difference in stress levels was found in the other five factors between girls and boys. This is inconsistent with previous research findings that examined Western versions of the *ASQ* (Byrne et al., 2007; De Vriendt et al., 2011; Moksnes et al., 2010), where girls tended to score higher on all stress subscales, which was also consistent with findings in the general literature on gender and

stress in adolescents (Jose & Ratcliffe, 2004; Rudolph, 2002). Nevertheless, Ge, Lorenz, Conger, Elder, and Simons (1994) and Ko, Yen, Chen, Chen, and Yen (2005) reported that no gender difference was found in the number of stressors among Chinese adolescents, and Hesketh et al. (2010) demonstrated similar frequency distribution of stressors across gender in Mainland China. However, the literature of gender difference in stress levels among Chinese adolescents is still limited and more studies are warranted.

#### Validity evidence

The EFA and CFA results have demonstrated construct validity of the *ASQ-CN* thoroughly in terms of the content and the factor structure. Additional evidence came from the criterion validity analyses. We found a negative association between different aspect of adolescent stress and levels of mindfulness, which is consistent with past studies and recent reviews (Chiesa & Serretti, 2009; Epel, Daubenmier, Moskowitz, Folkman, & Blackburn, 2009; Grossman et al., 2004; Khoury et al., 2013; Khoury et al., 2015). While the mechanism of how mindfulness-based stress reduction (MBSR) intervention facilitates psychological well-beings and health benefits has not been fully understood, Carmody and Baer (2008) and Nyklí ek and Kuijpers (2008) revealed the mediating effect of mindfulness, which in turn leads to stress reduction and improved well-being. Their findings allow the consistent negative correlations which emerged from the present study between the *ASQ-CN* scale and mindfulness measures to be claimed as indications of validity of these scales.

The present study also found a positive correlation between stress and behavioral problems in adolescence. Suldo and Huebner (2004) demonstrated that adolescents with positive life satisfaction were less likely to develop subsequent delinquent and aggressive behavior in the face of stressful life events. This finding may explain the unsurprising positive correlation between the *ASQ-CN* scale and the behavioral problem measure emerged from the present study, which provides another piece of validity evidence for the *ASQ-CN* scale.

#### Limitations

Several limitations to the present study should be noted. First, our data are from a kindergarten cohort and are not randomly collected, which may be less representative. Second, the sample size of the present study made it impossible to randomly split the sample into two halves to conduct EFA and CFA on each half, respectively. Since Guadagnoli and Velicer (1988) demonstrated that a solution with nine potential factors and 72 item variables required a sample of 300 or more with low loadings (=.4), our study was only able to conduct EFA with the available sample size and CFA on the same data as a remedy. Third, the test–retest reliability is not guaranteed, as the related data were not collected due to limited funding. However, the study has provided sufficient evidence of construct validity from the content, factorial, and criterion validity perspectives. In addition, the region of China where our study was conducted was well populated and included adolescents in urban, suburban, and rural areas. Generalizability of the factor structure to subregional groups may be limited.

#### Conclusions

In conclusion, our study is the first to validate the *ASQ* in the Chinese context and finds a six-factor structure of 42 items out of the 58 items in the original *ASQ* developed by Byrne et al. (2007). The factor structure of the *ASQ-CN* is distinct from that of Western versions of the *ASQ* in terms of both number of items and nature of the factors, which may be explained by cross-cultural differences. Further research is needed to provide addition information of test–retest reliability and confirm our exploratory factor structure using larger samples of Chinese adolescents.

#### Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Dimensional structure and psychometric properties of the ASQ-CN.

	Rotated	loadings			Ŭ	onfirmatory analysi	p <sup>s</sup>
					-	R <sup>2</sup> with	
Item description <sup>a</sup>	Equamax	$\operatorname{Promax}^b$	Communality	Item-total $r^c$	Own scale	Competing scale	Loadings
Factor 1 - Stress of romantic relationships (11.2% variance)							
Item 40: Not having enough time for your boy/girl-friend	LL.	.81	.75	.60	.72	.32	.85
Item 52: Getting along with your boy/girl-friend	.78	.80	LL.	.60	.72	.38	.85
Item 58: Breaking up with your boy/girl-friend	.73	.74	.71	.60	.66	.27	.81
Item 27: Making the relationship with your boy/girl-friend work	69.	69.	.66	.59	.58	.29	.76
Item 41: Teachers hassling you about the way you look	.61	.53	.59	.52	.51	.22	.71
Cronbach's alpha = .86							
Factor 2 - Stress of getting along with others (10.4% variance)							
Item 45: Not being listened to by teachers	.68	LT.	.75	69.	.61	.29	.78
Item 55: Lack of respect from teachers	.67	.74	.71	69.	.60	.27	77.
Item 44: Lack of trust from adults	.64	69.	.68	.72	.65	.32	.81
Item 53: Lack of freedom	.56	.62	.57	.66	.51	.22	.71
Item 48: Lack of understanding by your parents	.56	.57	.63	.71	.60	.32	ΤΤ.
Item 56: Disagreements between you and your peers	.52	.49	.59	69.	.54	.29	.73
Item 49: Parents hassling you about the way you look	.50	.48	.68	.66	.51	.36	.72
Item 31: Arguments at home	.48	.43	.63	.64	.48	.30	69.
Cronbach's alpha=.90							
Factor 3 - Stress of academic future uncertainty (10.3% variance)							
Item 47: Admission by a good high school	.70	.74	69.	.59	.59	.17	LT.
Item 7: Concern about your future	.66	.73	.57	.51	.53	.21	.73
Item 10: Other relatives except your parents expecting too much from you	.63	.72	.58	.57	.59	.24	LT.
Item 9: Keeping up with the school work	.54	.58	.50	.58	.48	.23	69.
Item 12: Difficulty with some subjects	.56	.57	.53	.56	.49	.26	.70
Item 46: Parents expecting too much from you	.56	.54	.63	.65	.58	.36	.76
Item 6: Teachers expecting too much from you	.53	.52	.49	.53	.49	.24	.70
Item 25: Not getting enough timely feedback on schoolwork	.50	.42	.64	.73	.53	.39	.73

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Item description <sup>a</sup>	Equamax	$\operatorname{Promax}^{b}$	Communality	Item-total $r^c$	Own scale	Competing scale	Loadings
Cronbach's alpha = .88							
Factor 4 - Stress of school/leisure conflict (9.5% variance)							
Item 19: Not having enough time for fun	.65	.71	.61	.61	.57	.24	.75
Item 26: Not enough time for activities outside of school hours	.63	.68	.61	.63	.55	.20	.74
Item 23: Not getting enough time for leisure	.61	.65	.59	.61	.57	.22	.76
Item 3: Getting up early in the morning to go to school	.60	.62	.51	.52	.50	.17	.71
Item 24: Having too much homework	.61	.61	.64	.64	.57	.31	.76
Item 5: Having to study things you don't understand	.54	.51	.58	99.	.53	.33	.73
Item 14: Having to concentrate too long during school hours	.50	.40	.57	.61	.48	.28	69.
Cronbach's alpha = .86							
Factor 5 - Stress of daily life (9.3% variance)							
Item 33: Compulsory school attendance	.57	.65	.59	.65	.51	.31	.71
Item 51: Not enough money to buy the things you need	.56	.63	.66	.70	.59	.31	ΤΤ.
Item 36: Satisfaction with how you look	.53	.61	.58	.58	.57	.24	.76
Item 35: Living at home	.51	.58	.67	.58	.50	.26	.71
Item 38: Not enough money to buy the things you want	.51	.57	.57	.64	.58	.27	.76
Item 42: Abiding by petty rules at school	.47	.47	.58	.62	.54	.29	.73
Item 57: Getting along with your teachers	.46	.44	.60	.67	.56	.37	.75
Cronbach's alpha = .86							
Factor 6 - Stress of parental authority and emerging autonomy (8.9% varianc	e)						
Item 2: Not being taken seriously by your parents	.56	.60	.52	.55	.47	.23	69.
Item 13: Abiding by petty rules at home	.55	.56	.56	.62	.52	.22	.73
Item 1: Disagreements between you and your father	.50	.55	.46	.52	.37	.19	.61

*Note.* N = 420.

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.76 .67 .66

.34 .33 .24 .29

.57 .52 .45 .44

.63 .63

> .55 .52

.60

.55 .50 .42 .40

.55 .52 .46

> Item 11: Having to take on new familial responsibilities with growing older Item 21: Disagreements between you and your brothers and sisters Item 8: Being hassled for not fitting in Cronbach's alpha = .82

Item 18: Disagreements between you and your teachers

.61

.46

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 $\frac{a}{2}$  Descriptions incorporate item context and items within each factor are ordered by promax loadings from the highest to the lowest.

 $b_{\rm E}$  brities are derived from promaxian oblique rotation at k = 4 where hyperplane count is maximized, with a equamax structure serving as the initial orthogonal solution.

 $c_{\rm Each}$  entry is a polyserial correlation with respective item excluded from the total instrument score.

factoring. R<sup>2</sup> for an item's own factor indicates the proportion of item variance predicted by other items in the hypothesized correct factor, whereas R<sup>2</sup> for an item's competing factor indicates variance d Entries are based on oblique principal-components cluster analysis (Anderberg, 2014; Harman, 1976), where hypothesized dimensional membership is determined through prior exploratory common predicted by items in the alternative factor. -

Table	2.
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#### Inter-factor correlations.

ASQ-CN scales (42 items)	1	2	3	4	5	6
Stress of romantic relationships	-					
Stress of getting along with others	.48	-				
Stress of academic future uncertainty	.13	.53	-			
Stress of school/leisure conflict	.39	.44	.57	-		
Stress of daily life	.58	.66	.48	.61	-	
Stress of parental authority and emerging autonomy	.51	.52	.47	.49	.59	-

Note. ASQ-CN: Chinese version of Adolescent Stress Questionnaire.

Measurement invariance testing for the six-factor model.

Invariance model	<b>x</b> <sup>2</sup>	df	CFI	<i>RMSEA</i> (90% CI)	Model comparison	Satorra-Bentler Scaled $\chi^2$	df	р
Configural	3100.660	1608	.923	.066 (.063, .070)	-	-	-	-
Metric	3140.082	1644	.922	.066 (.062, .069)	Configural vs. Metric	52.563	36	.037
Scalar	3181.374	1764	.927	.062 (.058, .065)	Metric vs. Scalar	146.797	120	.049

# Table 4.

Coefficients of congruence and internal consistency for generality of the composite ASQ-CN factor structure to gender subgroups and gender comparison of the factor scores.

	Coeffici	ients of ience <sup>a</sup>	Inte consis	rnal tency <sup>b</sup>	Boys $(n = 2!)$	6	Girls $(n = 20)$	Ē	
Sample size and ASQ-CN factor	Boys	Girls	Boys	Girls	(QS) W	Range	(QD)	Range	t
Ν	219	201	219	201					
Stress of romantic relationships	.91 (.23)	.94 (.25)	.84	.87	9.29 (4.26)	5-22	8.13 (4.09)	5-25	2.85*
Stress of getting along with others	<b>.90</b> (.19)	<b>.90</b> (.10)	89.	.91	17.00 (6.36)	8–34	16.78 (6.77)	8-40	.36
Stress of academic future uncertainty	<b>.97</b> (.20)	.73 (.25)	.88	.86	20.65 (6.99)	8–39	21.41 (6.84)	8-40	-1.12
Stress of school/leisure conflict	.96 (.15)	.91 (.23)	.87	.84	17.08 (6.08)	7–35	17.44 (5.65)	7–35	62
Stress of daily life	<b>.90</b> (.20)	.74 (.28)	.84	.88	13.69 (5.32)	7–29	12.70 (5.55)	7–35	1.86
Stress of parental authority and emerging autonomy	.94 (.20)	.73 (.24)	.83	.80	15.04 (5.46)	7–35	14.61 (5.20)	7–35	.83

Note. ASQ-CN: Chinese version of Adolescent Stress Questionnaire.

counterpart factor extracted from a given gender sample. Parenthetical values indicate similarity of the specified factor to the noncounterpart factor extracted from the given gender sample. Factor analyses <sup>a</sup>Entries are Wrigley-Neuhaus coefficients (Guadagnoli & Velicer, 1991). Nonparenthetical values indicate similarity of the respective factor extracted from the composite sample (as per Table 1) to the for the subsamples proceeded exactly as that for the composite sample. Coefficients equal to or greater than .70 are considered appreciable and in bold.

 $b_{\rm Entries}$  are the internal consistency based on coefficient alpha computed for items deemed salient according to the factor structure in the composite sample.

\* *p*<.05.

#### Table 5.

Correlations between ASQ-CN and measures of mindfulness and behavioral problems.

	С	orrelations	;
ASQ-CN	FFMQ	CAMM	YSR
Stress of romantic relationships	240*	254*	.296*
Stress of getting along with others	217*	167*	.330*
Stress of academic future uncertainty	210*	146*	.239*
Stress of school/leisure conflict	195*	208*	.241*
Stress of daily life	326*	303*	.362*
Stress of parental authority and emerging autonomy	264*	185*	.297*
Total score	297*	250*	.369*

Note. ASQ-CN: Chinese version of Adolescent Stress Questionnaire; FFMQ: Five Facet Mindfulness Questionnaire short form; CAMM: Child and Adolescent Mindfulness Measure; YSR: Youth Self-Report.

\* p < .001.