Journal of Pediatric Nursing 71 (2023) 111–119

Contents lists available at ScienceDirect

Journal of Pediatric Nursing

journal homepage: www.pediatricnursing.org

Translation and validation of the $STAR_x$ questionnaire in transitioning Chinese adolescents and young adults with chronic health conditions

Yunzhen Huang [a], Huaping Wang [b], Maria Diaz-Gonzalez de Ferris [c], Jian Qin [d,*]

[a] Division of Special Education and Counseling, California State University, Los Angeles, Los Angeles 90032, CA, United States
[b] Department of Clinical Nutrition, the First Affiliated Hospital of Chongqing Medical University, Chongqing 400016, China
[c] Department of Pediatrics, the University of North Carolina at Chapel Hill, Chapel Hill 27599, NC, United States
[d] Department of Cardiology, the First Affiliated Hospital of Chongqing Medical University, Chongqing 400016, China

ARTICLE INFO

Article history:
Received 14 June 2022
Revised 27 October 2022
Accepted 4 November 2022

Keywords:
Health care transition readiness
Self-management
$STAR_x$ questionnaire
Chronic health conditions
Chinese adolescents and young adults

ABSTRACT

Background: Adolescent/young adults (AYAs) with chronic conditions must undergo healthcare transition (HCT) preparation until their mid-twenties. Valid HCT readiness measures are lacking in China.
Methods: The present study translated, back-translated, and adapted the Self-Management and Transition to Adulthood with Rx = Treatment ($STAR_x$) Questionnaire. We examined the psychometric properties of this tool in a relatively large in-patient sample of AYAs with various chronic health conditions at a Chinese tertiary general hospital.
Results: We enrolled 624 AYAs aged 10–25 years (19.66 ± 3.64) with various chronic health conditions. The Chinese version of the $STAR_x$ Questionnaire demonstrated excellent internal consistency (Cronbach's alpha = 0.83) and reliability with a two-week test-retest (ICC = 0.88, $p < .001$). Furthermore, the Chinese version revealed a three-factor structure (self-management, disease knowledge, and provider communication) consistent with the revised English version of the $STAR_x$ Questionnaire. In terms of discriminant validity, the total score of the Chinese $STAR_x$ Questionnaire showed a significant positive correlation with age but no gender differences were found. In terms of predictive validity, the Chinese $STAR_x$ Questionnaire was significantly correlated with shorter length of hospitalization and higher frequency of emergency room visit, but the correlations became insignificant after controlling for age.
Conclusions: The results suggest that the Chinese version of the $STAR_x$ Questionnaire is a robust HCT readiness tool in AYAs with chronic conditions and clinicians may find it useful to develop individualized interventions.

Introduction

Health care transition (HCT) is the process of moving adolescents and young adults (AYAs) with chronic conditions from a pediatric, parent-supervised child model of care to an independent, patient-centered adult model of care with or without transferring to a new clinician (White et al., 2018). During the process of HCT, AYAs must develop essential knowledge, skills, and behaviors to manage their own chronic conditions and adjust to the adult model of care (Betz et al., 2014; Sawin et al., 2020). To facilitate HCT, in the United States, health care providers are recommended to evaluate AYAs' transition readiness starting age 12–14 (White et al., 2018) until their mid-twenties (Zhong et al., 2018). Existing HCT readiness measures usually assess AYAs' disease knowledge, disease self-management, medication management, and/or communication with healthcare provider (Parfeniuk et al., 2020).

In China, with the growing survival of children and adolescents with chronic medical conditions to adulthood (Dong et al., 2020), increased attention has been given to HCT and self-management skills, but relevant research and clinical practice is still at the preliminary stage. Currently there are no national guidelines for HCT or relevant interventions (Huang et al., 2021), and culturally adapted measures of HCT readiness/self-management skills are lacking. In a recent study, Huang et al. (2021) translated and validated the TRANSITION-Q (Klassen et al., 2015) in a sample of pediatric cancer survivors in Chinese children's hospitals, but it is unknown whether that scale is valid among AYAs with other chronic conditions.

General hospitals are the largest providers of pediatric care in China, accounting for 95.9% of all pediatric care hospitals (compared to 3.9% for maternal and child care hospitals and 0.2% for children's hospitals), and 77.2% of all pediatricians work in general hospitals (Zhang et al., 2019). In China, children's hospitals typically admit children and adolescents younger than 14 years (Huang et al., 2021; Zhang et al., 2019), while older AYAs receive healthcare services in general hospitals. But in

* Corresponding author.
E-mail address: hjqj2001@163.com (J. Qin).

https://doi.org/10.1016/j.pedn.2022.11.003
0882-5963/

practice, due to the limited availability of children's hospitals and depending on the expertise of clinicians in general hospitals, a number of pediatric patients below 14 years also receive care from general hospitals. Therefore, a large proportion of Chinese AYAs with chronic health conditions will have to go through, or continue to go through HCT in general hospitals. However, to our knowledge, there are no HCT readiness and self-management measures in this setting validated in China. Meanwhile, Chinese healthcare workers in general hospitals are overstressed with heavy workloads that are continuing to grow over the years (Huang et al., 2020; Zhang et al., 2019), calling for the development of a convenient self-administered tool to evaluate self-management skills and HCT readiness.

Considering the unique situation in China, we aimed to develop a brief, culturally adapted, and generic measure of HCT readiness and self-management that can be applied to Chinese AYA patients in general hospitals. For the purpose of this study, we translated, back-translated, adapted, and validated the Self-Management and Transition to Adulthood with Rx = Treatment Questionnaire ($STAR_x$;Ferris et al., 2015; Nazareth et al., 2018).

Methods

Participants

Participants were recruited between April and December 2020, from the inpatient wards of multiple specialties (e.g., endocrinology, hematology, nephrology, neurology, and ophthalmology) in a general hospital in Southwest China. The eligibility criteria were (a) adolescents and young adults, operationalized as 10–24 years of age (World Health Organization, 2022), (b) with at least one chronic health condition, operationalized as any medical condition that lasts 12 months or longer and requires ongoing medical attention and/or limits one's level of functioning (Agency for Healthcare Research, 2020), and (c) able to understand the survey questions, operationalized as no diagnosis of intellectual disability in the patient's medical record and no self-report of intellectual disability.

Procedures

$STAR_x$ questionnaire Chinese translation and adaptation

The translation and validation of the $STAR_x$ Questionnaire (Ferris et al., 2015) was authorized by its author, Maria Diaz-Gonzalez de Ferris, MD, MPH, PhD. The study (including the pilot test and the formal study) was approved by the Institutional Review Board (IRB) of the hospital (IRB # 2019–223). The self-administered $STAR_x$ Questionnaire measures self-management and HCT readiness skills in children and AYAs with various chronic health conditions both in pediatric and adult-focused settings (Ferris et al., 2015; Nazareth et al., 2018). It was rated as a well-established measure (Parfeniuk et al., 2020) and has been used as a gold standard to establish the criterion validity of other transition readiness measures (Cheak-Zamora et al., 2021). The original scale was developed by Ferris et al. (2015) at the University of North Carolina and included 18 items with six subscales: medication management, provider communication, engagement during appointments, disease knowledge, adult health responsibilities, and resource utilization.

The $STAR_x$ Questionnaire was validated among AYAs with chronic conditions aged 12 to 25 years and showed adequate internal reliability and test-retest reliability (Ferris et al., 2015) as well as concurrent, predictive, and discriminant validity (Cohen et al., 2015). The scale was later revised by Nazareth et al. (2018), including 13 items under three subscales: disease knowledge, self-management, and provider communication. The revised scale was validated among pediatric patients aged 6 to 18 years and demonstrated good internal consistency (Nazareth et al., 2018), but the validity was not evaluated. Compared to the revised $STAR_x$ Questionnaire for the pediatric setting (Nazareth et al., 2018), the original scale (Ferris et al., 2015) was validated in older AYAs, more consistent with the ages of AYAs in Chinese general hospitals. Additionally, considering the characteristics of Chinese general hospitals, $STAR_x$ Questionnaire for adult-focused settings was used, instead of the pediatric-focused version. The two versions are identical except for question 18, which asks "*How easy or hard do you think it will be for you to move from pediatrics to adult-focused care?*" in the pediatric-focused version, and "*How easy or hard do you think it will be for you to find other doctors?*" in the adult-focused setting version (UNC $STAR_x$ Program, 2021). Hence, we utilized the $STAR_x$ Questionnaire adult-setting version of the original $STAR_x$ Questionnaire (Ferris et al., 2015).

Translation of the $STAR_x$ Questionnaire followed the guidelines for translation, adaptation, and validation of instruments in healthcare research (Sousa & Rojjanasrirat, 2011). A member of the research team (native Chinese speaker, bilingual/bicultural, and knowledgeable about medical terminology and the content area of the construct) and a chemistry major Chinese international doctoral student in the United States (native Chinese speaker, bilingual and bicultural, and not knowledgeable about medical terminology and the content area of the construct) translated the original $STAR_x$ Questionnaire into Chinese. Discrepancies in the two translated versions were discussed and resolved within the research team. The initial translated version was back-translated to English by a registered nurse in the United States (native English speaker, bilingual/bicultural, knowledgeable about medical terminology and the content area of the construct) and a psychology major undergraduate student in the United States (native English speaker, bilingual/bicultural, not knowledgeable about medical terminology and the content area of the construct). Discrepancies between the two back-translated versions were discussed and resolved by the research team. The research team then compared the back-translated version and the original $STAR_x$ Questionnaire, consulted with the forward and backward translators, discussed and resolved the discrepancies, and developed a pre-final translated version.

The pre-final translated version was pilot-tested among ten patients with chronic health conditions (e.g., leukemia, lymphoma, systemic lupus erythematosus, chronic kidney disease), ages 13–23 years (mean 18.4 ± 3.95), and included three females. All patients agreed to participate in the pilot test and signed the paper consent forms if they were 18 years or older. For those under 18 years, the patients and their caregiver signed the paper assent and consent forms, respectively. Each patient was individually interviewed by a research team member, and was asked to read the questionnaire and rate on a dichotomous scale (yes/no) whether the instructions and the items were clear. If the patient rated "no" for an item, follow-up question was asked regarding how to change the statement to make the language clearer. Overall, patients commented that the instructions and items were clear and easy to understand, and all items met the requirement of a minimum of 80% inter-rater agreement (Sousa & Rojjanasrirat, 2011). Hence, no revision was made to the pre-final translated version, and it was used as the final translated version.

Validation of the Chinese $STAR_x$ questionnaire

To validate the Chinese $STAR_x$ Questionnaire, the convenience sampling method was used to recruit participants. A member of the research team reviewed the medical records of hospital patients and identified eligible participants. Three members of the research team approached the eligible participants in person and invited them to participate in this study. For those who agreed to participate and were below 18 years, the patients and the caregivers read and signed the paper assent and consent forms, respectively. The participants then scanned the QR code with their own cell phones to complete the online survey through Sojump, an online survey platform commonly used in China. The online survey included demographic questionnaire (completed by caregivers) and the Chinese $STAR_x$ Questionnaire (completed by the patients). For those who agreed to participate and were above 18 years, the patients read and signed the paper consent forms, scanned the QR code with their own cell phones, and completed the Sojump online survey on their own. The research team member was

present to ensure the completion of the survey and assist with technical issues.

Additionally, to examine the test-retest reliability, 116 participants were randomly selected to complete the Chinese $STAR_x$ Questionnaire again via Sojump online survey platform two weeks later. The random selection was fulfilled through generating 116 numbers using a web-based random number generator prior to data collection, and those with study IDs equal to the selected numbers were invited for the retest.

Measures

Demographic/healthcare utilization questionnaire

It included age, gender, education level, main chronic medical diagnosis, time since diagnosis (measured in days), and healthcare utilization over the past three months (hospitalizations, days of hospitalization, and frequency of emergency room [ER] visits).

Healthcare transition readiness

The Chinese version of the $STAR_x$ Questionnaire was used to measure self-management and HCT readiness. Consistent with the original $STAR_x$ Questionnaire (Ferris et al., 2015), the initial translated version has 18 items rated on a 5-point Likert scale (1 = "never", "nothing", or "very hard", 5 = "always", "a lot", or "very easy"). For items related to medication, an additional "N/A" response is included to capture situations with no prescribed medicines. A higher total score indicates a higher level of transition readiness. The complete Chinese version of the $STAR_x$ Questionnaire was included in Appendix A.

Statistical analysis

We used expectation maximization algorithm (Graham et al., 2013) to impute the missing values caused by the "N/A" responses. The full sample was randomly divided into two subsamples using SPSS 28, resulting in a subsample of 310 participants (subsample 1) and a subsample of 314 participants (subsample 2). Subsample 1 was used to perform item analysis and exploratory factor analysis (EFA), and subsample 2 was used to perform confirmatory factor analysis (CFA).

Pearson correlation examined item-total correlation and inter-item correlation. Items with low item-total correlations (i.e., $r < 0.40$, suggesting irrelevance; Ware Jr. & Gandek, 1998) or high interitem correlations (i.e., $r > 0.80$, suggesting redundancy; Rattray & Jones, 2007) were deleted from the scale. Construct validity was examined through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA with principal axis factoring and promax rotation was conducted to extract the factor structure of the Chinese $STAR_x$ Questionnaire. Factors with an eigenvalue ≥1 were extracted, and items with a factor loading of ≥0.40 were considered representative of the corresponding factor (Backhaus et al., 2006). The following criteria were used in the CFA to determine absolute and relative model fit: relative Chi-square (χ^2/df) ≤ 3, root mean square error of approximation (RMSEA) < 0.08, standardized root mean square (SRMR) ≤ 0.08, comparative fit index (CFI) ≥ 0.95, and Taylor-Lewis index (TLI) ≥ 0.95 (Schreiber et al., 2006).

The full sample was used to examine internal consistency, test-retest reliability, predictive validity, and discriminant validity. Internal consistency was examined using Cronbach's alpha. Test-retest reliability was examined using intraclass correlation (ICC) with the two-way mixed model and the absolute agreement type (Koo & Li, 2016). An ICC estimate value higher than 0.75 indicates good reliability (Koo & Li, 2016). Predictive validity was examined through Pearson correlations between the revised scale scores and healthcare utilization over the past three months. Discriminant validity was examined through Pearson correlations between the revised scale scores, age, and time since diagnosis, and independent samples *t*-test of gender differences in the revised scale scores. CFA was conducted in SPSS Amos 28, and all the other analyses were conducted in SPSS 28.

Finally, the descriptive statistics and measurement errors of the Chinese $STAR_x$ Questionnaire were provided. The standard error of measurement (SEM) for the full scale and the subscales was calculate by the formula: $SEM = SD \times \sqrt{(1 - ICC)}$, where SD was the standard deviation of the sample at baseline, and ICC was the test-retest reliability (Darter et al., 2013). The SEM measures the precision of an assessment, with smaller value indicating greater precision. The smallest detectable change (SDC) for the full scale and the subscales was calculate by the formula: $SDC = SEM \times 1.96 \times \sqrt{2}$ (Darter et al., 2013). The SDC estimates the smallest measured change score that is considered a true change, rather than a result of measurement error.

Regarding sample size, the guideline (Sousa & Rojjanasrirat, 2011) recommends using at least 10 participants per item of the measure for general psychometric approaches (item analysis, Pearson's correlations, and EFA) and 300–500 participants for CFA. Therefore, to validate the Chinese version of the $STAR_x$ Questionnaire, the current study required at least 480 participants, with 180 participants for general psychometric approaches and EFA, and 300 participants for CFA. With 624 participants, the sample size of this study was sufficient for scale validation.

Results

Participant characteristics

A total of 624 participants completed the Sojump online survey. Participant characteristics of the full sample were presented in Table 1. There were 70 participants (11.2%) with no prescribed medications and responded "N/A" to the medication questions in the $STAR_x$ Questionnaire. These "N/A" responses were treated as missing data and estimated values were imputed using the expectation maximization algorithm (Graham et al., 2013).

The full sample was randomly divided into two subsamples for general psychometric approach and EFA (subsample 1, $n = 310$) and CFA (subsample 2, $n = 314$), respectively. No significant differences were found between the two subsamples in terms of age, time since diagnosis, sex, and education level. In addition, out of the 116 participants randomly selected for two-week retest, 81 completed the retest survey.

Item analysis

Item-total correlation

Pearson correlation between the item scores and the total score of the Chinese $STAR_x$ Questionnaire was performed in subsample 1. Five items (items 2, 5, 6, 8, 16) had low item-total correlation (i.e., $r < 0.40$; Ware Jr. & Gandek, 1998) and were thus deleted from the scale. The remaining 13 items were renumbered, a new total score was calculated, and another item-total correlation analysis was performed. Results were shown in Table 2. The item-total correlation coefficients of the remaining 13 items were 0.45–0.65.

Interitem correlation

Pearson correlation between the remaining 13 items was performed in subsample 1. Results were presented in Table 2. None of the interitem correlations exceeded 0.80, hence no items were deleted. However, the correlation between items 9 and 10 (i.e., items 13 and 14 in the original scale) was higher than 0.70, indicating potential redundancy (Rattray & Jones, 2007) and requiring further attention in the CFA.

Construct validity

Exploratory factor analysis (EFA)

EFA with principal axis factoring and promax rotation was conducted among the remaining 13 items using subsample 1. EFA extracted three factors (Table 3). After examining the items and comparing them to the revised $STAR_x$ Questionnaire (Nazareth et al., 2018), the three factors of the Chinese $STAR_x$ Questionnaire were named "self-

Table 1
Participant Characteristics (n = 624).

	N (%) or M (SD)
Age	19.66 (3.64) Range: 10–25
Time Since Diagnosis (days)	567.75 (1182.01) Range: 0–8761
Males	347 (55.6%)
Chronic Medical Conditions	
Endocrine and metabolic diseases (e.g., diabetes mellitus, thyroid cancer, obesity)	168 (26.9%)
Urinary system diseases (e.g., chronic kidney disease, nephrotic syndrome)	69 (11.1%)
Neurological diseases (e.g., epilepsy, multiple sclerosis)	65 (10.4%)
Hematological diseases (e.g., leukemia, lymphoma)	56 (9.0%)
Ear nose throat diseases (e.g., chronic sinusitis, rhinitis, or otitis media)	54 (8.7%)
Eye diseases (e.g., uveitis, concomitant exotropia)	45 (7.2%)
Musculoskeletal diseases (e.g., chronic pain, osteogenesis imperfecta)	37 (5.9%)
Multisystem disease (e.g., systemic lupus erythematosus, rheumatoid arthritis)	35 (5.6%)
Gastrointestinal diseases (e.g., Crohn's disease, colon/rectum/liver cancer)	31 (5.0%)
Circulatory system diseases (e.g., hypertension, congenital heart disease)	25 (4.0%)
Skin diseases (e.g., psoriasis, vasculitis)	12 (1.9%)
	27 (4.4%)
Education Level	
Elementary school	31 (5.0%)
Junior high school	128 (20.5%)
Senior high school	172 (27.6%)
Undergraduate or associate college degree	280 (44.9%)
Graduate degree and above	13 (2.1%)
Health Care Utilization over the Past Three Months	
Hospitalization frequency	1.32 (0.97) Range: 0–14
Hospitalization length	9.42 (14.44) Range: 0–92
ER visit frequency	0.39 (0.74) Range: 0–6

management," "disease knowledge," and "provider communication." Factor 1 Self-Management included five items and explained 12.21% of the total variance. Factor 2 Disease Knowledge included three items and explained 7.88% of the total variance. Factor 3 Provider Communication included five items and explained 30.07% of the total variance. The three factors together explained 50.16% of the total variance.

Confirmatory factor analysis (CFA)

CFA was conducted using subsample 2. Due to the high correlation between items 9 and 10 (i.e., items 13 and 14 in the original scale), correlation between their error terms was added to the model (Gunzler & Morris, 2015; see Fig. 1). Regarding model fit indices, relative Chi-square = 2.43, RMSEA = 0.068 (90% CI = 0.054–0.081), SRMS = 0.065, CFI = 0.94, TLI = 0.93. Three indices (relative Chi-square, RMSEA, SRMS) met the criteria, while CFI and TLI were slightly lower than the cutoff value of 0.95 (Schreiber et al., 2006). Overall, the three-factor model was an acceptable fit to the data.

Internal consistency

Cronbach's alphas of the full scale and the three subscales were calculated across the full sample. For the full scale, Cronbach's alpha = 0.83. At a subscale level, Cronbach's alpha was 0.78 for self-management, 0.80 for disease knowledge, 0.82 for provider communication.

Two-week test-retest reliability

ICC between the Chinese STAR$_x$ Questionnaire scores at baseline and two-week retest was calculated in the retest subsample. For the full scale, ICC = 0.88, $p < .001$. At a subscale level, ICC was 0.80 for self-management, 0.78 for disease knowledge, 0.80 for provider communication. For all subscales, $p < .001$.

Descriptive statistics and measurement error

The full sample ($n = 624$) was used to calculate descriptive statistics and measurement error (i.e., SEM and SDC) of the final version of the Chinese STAR$_x$ Questionnaire. Results were shown in Table 4.

Discriminant validity

Pearson correlation analyses were conducted between the Chinese STAR$_x$ Questionnaire scores and age and time since diagnosis. Older age had a significant correlation with higher Chinese STAR$_x$ Questionnaire total score ($r = 0.31$, $p < .001$) and subscale scores (for self-management, $r = 0.41$, $p < .001$; for disease knowledge, $r = 0.11$, $p < .01$; for provider communication, $r = 0.12$, $p < .01$). Time since diagnosis did not significantly correlate with the total score or subscale score.

Independent samples *t*-test was conducted to examine gender differences in Chinese STAR$_x$ Questionnaire scores. Results showed that males and females did not differ in the total score and subscale scores.

Predictive validity

Pearson correlation was used to examine the association of the Chinese STAR$_x$ Questionnaire full scale and subscale scores with health care utilization over the past three months, including frequency of hospitalization, days of hospitalization, and frequency of ER visits. Higher Chinese STAR$_x$ Questionnaire total score was significantly

Table 2
Item-Total Correlations and Interitem Correlations Chinese STAR$_x$ Questionnaire.

Item	Original item #	Total score	1	2	3	4	5	6	7	8	9	10	11	12
1	1	0.45***												
2	3	0.65***	0.47***											
3	4	0.64***	0.21***	0.49***										
4	7	0.56***	0.24***	0.48***	0.48***									
5	9	0.62***	0.37***	0.53***	0.31***	0.46***								
6	10	0.54***	0.13*	0.25***	0.24***	0.25***	0.26***							
7	11	0.59***	0.18**	0.31***	0.23***	0.31***	0.33***	0.69***						
8	12	0.55***	0.08	0.30***	0.31***	0.24***	0.23***	0.53***	0.54***					
9	13	0.59***	0.15**	0.22***	0.22***	0.10	0.27***	0.24***	0.24***	0.22***				
10	14	0.64***	0.15**	0.21***	0.21***	0.16***	0.34***	0.22***	0.25***	0.31***	0.74***			
11	15	0.59***	0.16**	0.18**	0.33***	0.10	0.14*	0.22***	0.21***	0.21***	0.42***	0.47***		
12	17	0.51***	0.11*	0.14*	0.27***	0.08	0.15**	0.06	0.14*	0.07	0.32***	0.39***	0.47***	
13	18	0.58***	0.10	0.16**	0.25***	0.08	0.14*	0.14*	0.19***	0.20***	0.44***	0.50***	0.60***	0.61***

*$p < .05$, **$p < .01$, ***$p < .001$ (two-tailed).

Table 3
Factor Loadings of the Chinese STAR$_x$ Questionnaire.

Item and description	Original item #	Factor 1 Self-management	Factor 2 Disease knowledge	Factor 3 Provider communication
1 – Try to understand what doctor tells you	1	**0.53**	−0.10	0.03
2 – Ask doctors or nurse questions about illness or medical care	3	**0.86**	−0.04	−0.04
3 – Made your own appointments	4	**0.51**	0.03	0.16
4 – Use the internet, books, etc. to find out more about your illness	7	**0.64**	0.08	−0.10
5 – Work with doctor to take care of new health problems	9	**0.63**	0.05	0.03
6 – Knowledge about your illness	10	−0.07	**0.88**	−0.04
7 – Knowledge about taking care of your illness	11	0.03	**0.81**	−0.01
8 – Knowledge about the consequences of not taking meds	12	0.04	**0.62**	0.06
9 – Talk to your doctor	13	0.02	0.10	**0.62**
10 – Make a plan with doctor to care for your health	14	0.03	0.10	**0.69**
11 – See doctor by yourself	15	−0.01	0.03	**0.70**
12 – Take care of yourself	17	0.04	−0.14	**0.67**
13 – Find other doctors	18	−0.07	−0.05	**0.83**

Note. Items falling under the corresponding factor were bolded. The complete Chinese STAR$_x$ questionnaire is provided in Appendix A.

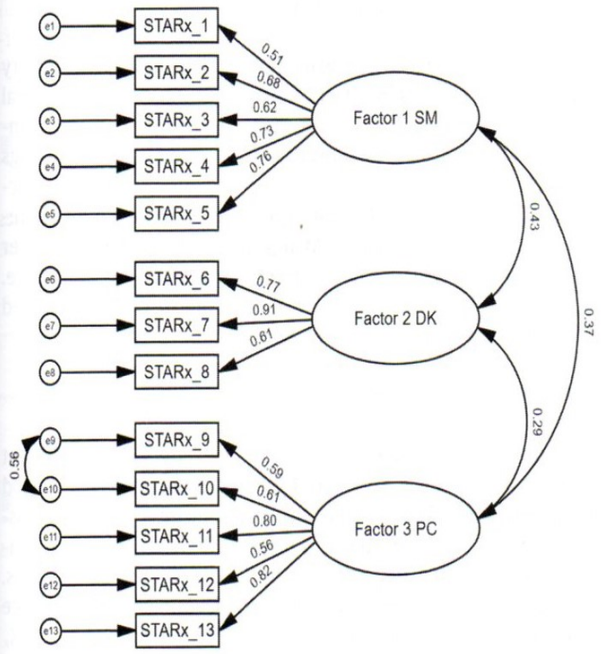

Fig. 1. Factor Structure of the Chinese STARx Questionnaire.
Note. SM = self-management, DK = disease knowledge, PC = provider communication.

correlated with shorter length of hospitalization ($r = -0.12, p < .01$) and higher frequency of ER visits ($r = 0.08, p < .05$). Higher self-management subscale score was significantly correlated with higher frequency of ER visits ($r = 0.13, p < .001$). Higher provider communication subscale score was significantly associated with lower frequency ($r = -0.11, p < .01$) and shorter length of hospitalization ($r = -0.15$, $p < .01$). However, after controlling for age, the partial correlations between the Chinese STAR$_x$ Questionnaire and health care utilization were no longer statistically significant. Subsequent Pearson correlation analysis showed that older age was significantly correlated to higher frequency of ER visits ($r = 0.14$, $p < .001$).

Table 4
Descriptive Statistics and Measurement Error of the Chinese STAR$_x$.

Subscales/Full Scale	M (SD)	SEM	SDC
Self-management subscale	19.26 (4.44)	1.99	5.50
Disease knowledge subscale	11.14 (2.59)	1.21	3.37
Provider communication subscale	19.29 (4.03)	1.80	5.00
Full Scale	49.69 (8.32)	2.88	7.99

Note. SEM = standard error of measurement, SDC = smallest detectable change.

Discussion

The current study translated, back-translated and adapted the STAR$_x$ in Chinese Questionnaire, examining its psychometric properties in a relatively large sample of Chinese AYAs with different chronic health conditions. To our knowledge, this is the first authorized study to translate, adapt, and validate the STAR$_x$ in a general hospital setting in China. Overall, the Chinese STAR$_x$ demonstrated excellent internal consistency and two-week test-retest reliability, as well as good construct and discriminant validity. While this paper focuses on the research validity of this instrument, there are clinically relevant items that did not perform as well, but represent important HCT skills in medication adherence and medication self-management. The deleted items are included in Appendix A to assist with clinical decision making (UNC STAR$_x$ Program, 2021) particularly when assessing transition readiness in patients who are taking medications for their chronic health conditions, and for researchers to further improve the Chinese STAR$_x$ Questionnaire.

The Chinese STAR$_x$ Questionnaire revealed a three-factor structure, which was inconsistent with the original STAR$_x$ Questionnaire (Ferris et al., 2015), but consistent with its revised version (Nazareth et al., 2018). Both scales yielded three factors, namely self-management, disease knowledge, and provider communication. However, there were discrepancies in the content of the self-management subscale, with only one item (try to understand doctor's words) mutually included in both scales. The revised STAR$_x$ Questionnaire (Nazareth et al., 2018) self-management subscale stressed more on medication management (e.g., forget to take medications [reverse scored], take medications as supposed to), while in the Chinese STAR$_x$ Questionnaire, the self-management subscale focused more on skills to manage health issues in general (e.g., ask doctors or nurse questions about illness or healthcare, and make their own appointments). The discrepancies may be attributed to differences in study sample and study context. In the study by Nazareth et al. (2018), the participants were younger children who were mainly diagnosed with six types of chronic diseases (e.g., kidney disease, inflammatory bowel disease, diabetes) and were taking at least one medication. In contrast, 11.2% of our participants were not taking medications and had more diverse diagnoses. With the inclusion of a wider age range and a greater span of chronic diseases, the Chinese STAR$_x$ Questionnaire may better meet the needs of clinicians for a generic self-management and HCT readiness measure in general hospital settings. Furthermore, the Chinese STAR$_x$ Questionnaire placed less emphasis on medication management and may better accommodate for Chinese AYAs with chronic conditions who are not prescribed with medications.

The validity of the Chinese STAR$_x$ Questionnaire was further supported by its significant correlation with age. Consistent with the prior findings in the United States (Cohen et al., 2015; Nazareth et al.,

2018) and Mexico (Cantú-Quintanilla et al., 2015), age was positively associated with the Chinese $STAR_x$ Questionnaire, indicating that older AYAs tend to have greater transition readiness. In terms of predictive validity, the Chinese $STAR_x$ Questionnaire and its subscales were significantly correlated with health care utilization, but the relationships were no longer significant after controlling for age. The findings were consistent with those in the original $STAR_x$ Questionnaire validation study (Cohen et al., 2015), but studies in western culture have generally shown mixed results in the relationship between HCT readiness and health care utilization (Fenton et al., 2015; Traino et al., 2021). It is important to further investigate and clarify their relationship in future studies.

A finding of particular interest was the significantly positive correlation between $STAR_x$ Questionnaire score and frequency of ER visits, while the correlation was no longer significant after controlling for age. We hypothesize that the correlation between $STAR_x$ Questionnaire and health care utilization might be a spurious correlation, where both variables were related to age, causing a "false" correlation between the two variables. Although such studies have not been conducted in China, studies in the United States have supported the positive correlations between age and transition readiness (Ferris et al., 2015) as well as age and emergency room visit among AYAs (Holland et al., 2022).

Several findings from this study suggest the need to further revise the Chinese $STAR_x$ Questionnaire and improve its utility in the Chinese cultural context. First, the EFA identified three factors that jointly explained 50.16% of the total variance. The total variance explained by these factors met the minimal criterium of 50% but was still lower than the ideal range of 75%–90% (Beavers et al., 2013), which suggests that the items are not sufficient enough to explain the model. More efforts are needed to expand the three subscales and to explore new factors of HCT readiness in Chinese culture. For instance, family plays an important role in chronic illness management in China. Family (rather than individual) is seen as the basic unit of society, and family members are morally obligated to care for each other, especially children and those who are ill (Cheung et al., 2005). Often times the family (rather than AYAs themselves) jointly works with the doctor to manage AYAs' chronic illness and develop health care plans. Therefore, we propose that adding items related to AYA's collaboration with parents/caregivers (rather than relying on parents/caregiver) in their own chronic condition management might be a unique component of HCT readiness in the Chinese cultural context.

Second, the provider communication subscale includes an item about taking care of themselves (item 12), which seems more relevant for self-management. However, interitem correlation, EFA, and CFA consistently showed a stronger relationship between this item and the other four items in the corresponding subscale. These items shared commonality in how the question was worded (i.e., "*how easy or hard is it to/do you think…?*"). These questions might be assessing the respondent's self-efficacy instead, which refers to an individual's belief in their capacity to successfully perform a behavior (Bandura, 1977). Previous literature has found a significant positive association between HCT readiness and self-efficacy for chronic illness management in children and adolescents with chronic conditions in the United States (Cohen et al., 2015), as well as HCT readiness and general self-efficacy in Chinese adolescent cancer survivors (Huang et al., 2021). Future research should investigate the strength of relationship between self-efficacy and the Chinese $STAR_x$ Questionnaire, particularly the provider communication subscale, to examine the overlap between the constructs.

Practice implications

To our knowledge, the Chinese $STAR_x$ Questionnaire adapted and validated in this study was the first health care transition readiness assessment tool for generic use among adolescents and young adults with a large variety of chronic medical conditions in Chinese general hospital setting, which accounts for 95.9% of all pediatric care hospitals (Zhang et al., 2019) and serves relatively older adolescents and young adults who are approaching or going through health care transition (White et al., 2018; Zhong et al., 2018). Given the lack of national guidelines for health care transition in China (Huang et al., 2021), the Chinese $STAR_x$ Questionnaire can be used as a program evaluation outcome measure to inform the development of effective and evidence-based health care transition programs or interventions.

In clinical practice, the Chinese $STAR_x$ Questionnaire can serve as a convenient assessment tool for transition readiness. It is self-administered by the patient and can be completed within 3–5 min. Clinicians can utilize the Chinese $STAR_x$ Questionnaire to quickly assess patients' transition readiness, which can be used to aid the development of targeted health care transition interventions. Furthermore, through routine administration of the Chinese $STAR_x$ Questionnaire, clinicians can monitor patients' changes in transition readiness and modify the health care transition intervention to maximize transition outcomes.

Limitations

The current study had several limitations. First, the external validity of the study might be limited by its sample (AYA inpatients in a general hospital in Southwest China) and sampling method (convenience sampling). Researchers should be cautious when generalizing the findings to patients with different demographic characteristics. Second, predictive validity was established using a cross-sectional design, so the results might be biased. Longitudinal studies are needed to further explore the predictive validity of the Chinese $STAR_x$ Questionnaire. Third, concurrent validity was not examined, due to a lack of validated HCT readiness measures in China during the time of data collection.

Conclusion

In this study, the Chinese $STAR_x$ Questionnaire showed excellent internal consistency and two-week test-retest reliability, as well as good construct and discriminant validity. It is a psychometrically valid tool to assess self-management skills and HCT readiness in AYAs with chronic conditions who are receiving medical care in Chinese general hospitals. Investigators may utilize the Chinese $STAR_x$ Questionnaire to advance the research in HCT readiness. Clinicians may utilize the Chinese $STAR_x$ Questionnaire to evaluate AYA's HCT readiness and inform the development of individualized readiness programs and interventions.

Funding

N/A

CREDIT Statement

Yunzhen Huang: Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing – original draft, Visualization. **Huaping Wang:** Investigation, Writing – review & editing. **Maria Diaz-Gonzalez de Ferris:** Resources, Writing – review & editing. **Jian Qin:** Conceptualization, Investigation, Resources, Writing – review & editing, Supervision, Project administration.

Declarations of interest

None.

Acknowledgments

The authors would like to acknowledge the translators Haoran Lei, Sweeshan Leuw, and Yuqi Li. The authors would like to thank our colleagues and physician specialists Jiangju Huang, Yuping Zhang, Jianyu Wang, Kun Huang, Juan Yang, Pei Zhao, Yanlai Zhang, Hui Wang, Gang

Xiao, Junwen Zhang, Huimin Du, Gang Yang, Delin Wang, Ling Luo, and Du Cao for providing consultation on the chronic medical conditions. The authors would also like to thank all participants for participating in the research and Maria Diaz-Gonzalez de Ferris, MD, MPH, PhD for her permission to translate her $STAR_x$ Questionnaire and support for this project.

Appendix A. Chinese version of the $STAR_x$ questionnaire

第一部分:请根据您在过去3个月内的情况，回答下列问题。答案没有对错之分。
在过去3个月内.....

	$STAR_x$ 原题号	1 从不	2 几乎从不	3 有时	4 几乎总是	5 总是
1. 你是否尽力去理解医生告诉你的话? How often did you make an effort to understand what your doctor told you?	1					
2. 你是否向你的医生/护士询问自己的疾病，药物或治疗? How often did you ask your doctor or nurse questions about your illness, medicines or medical care?	3					
3. 你是否自己预约挂号? How often did you make your own appointments?	4					
4. 你是否通过网络，书本或其他指南来了解更多有关你疾病的信息? How often did you use the internet, books or other guides to find out more about your illness?	7					
5. 你是否和你的医生一同处理新出现的健康问题? How often did you work with your doctor to take care of new health problems that came up?	9					

第二部分:请根据您自己的情况，回答下列问题。答案没有对错之分。

	$STAR_x$ 原题号	1 一点也不了解	2 了解得不多	3 了解一点	4 了解一些	5 了解很多
6. 你对自己的疾病了解多少? How much do you know about your illness?	10					
7. 你对自己疾病的保养注意事项了解多少? How much do you know about taking care of your illness?	11					

		1 一点也不了解	2 了解得不多	3 了解一点	4 了解一些	5 了解很多	6 我现在不吃药/用药
8. 你对自己不吃药/用药的后果了解多少? How much do you know about what will happen if you do not take your medicines?	12						

第三部分:请根据您自己的情况，回答下列问题。答案没有对错之分。

	$STAR_x$ 原题号	1 非常困难	2 有点困难	3 不难也不容易	4 有点容易	5 非常容易
9. 你觉得与你的医生沟通困难吗? How easy or hard is it to talk to your doctor?	13					
10. 你觉得与你的医生一起制定保持健康的计划困难吗? How easy or hard is it to make a plan with your doctor to care for your health?	14					
11. 你觉得独自去见你的医生困难吗? How easy or hard is it to see your doctor by yourself?	15					
12. 你觉得自己照顾自己困难吗? How easy or hard is it to take care of yourself?	17					
13. 你觉得找其他医生看病困难吗? How easy or hard do you think it will be for you to find other doctors?	18					

Three subscales:

1. Self-management (自我管理): sum items 1, 2, 3, 4, 5
2. Disease knowledge (疾病知识): sum items 6, 7, 8
3. Provider communication (医患沟通): sum items 9, 10, 11, 12, 13

Deleted items:

第一部分:请根据您在过去3个月内的情况，回答下列问题。答案没有对错之分。
在过去3个月内.....

	$STAR_x$ 原题号	1 从不	2 几乎从不	3 有时	4 几乎总是	5 总是	6 我现在不吃药/用药
14. 你是否记得自己吃药/用药? How often did you take your medicines on your own?	2						
15. 你是否需要其他人提醒你吃药/用药? How often did you need someone to remind you to take your medicines?	5						

(continued on next page)

(*continued*)

第一部分:请根据您在过去3个月内的情况，回答下列问题。答案没有对错之分。 在过去3个月内.....	$STAR_x$ 原题号	1 从不	2 几乎从不	3 有时	4 几乎总是	5 总是	6 我现在不吃药/用药
16. 你是否用药盒、日历或闹钟等物品来提醒自己按时吃药/用药? How often did you use things like pillboxes, schedules, or alarm clocks to help you take your medicines when you were supposed to?	6						
17. 你是否忘记吃药/用药? How often did you forget to take your medicines?	8						

第三部分:请根据您自己的情况，回答下列问题。答案没有对错之分。	$STAR_x$ 原题号	1 非常困难	2 有点困难	3 不难也不容易	4 有点容易	5 非常容易	6 我现在不吃药/用药
18. 你觉得按照医生的嘱咐吃药/用药困难吗? How easy or hard is it to take your medicines like you are supposed to?	16						

References

Agency for Healthcare Research (2020). User guide: Chronic condition indicator for ICD-10-CM, v2021.1 (Beta version). Retrieved September 22, 2022, from https://www.hcup-us.ahrq.gov/toolssoftware/chronic_icd10/CCI-ICD10CM-User-Guide-v2021-1.pdf.

Backhaus, K., Erichson, B., Plinke, W., & Weiber, R. (2006). *Multivariate analysis methods: An application-oriented introduction*. Springer.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191.

Beavers, A. S., Lounsbury, J. W., Richards, J. K., Huck, S. W., Skolits, G. J., & Esquivel, S. L. (2013). Practical considerations for using exploratory factor analysis in educational research. *Practical Assessment, Research & Evaluation, 18*(6), 1–13. https://doi.org/10.7275/qv2q-rk76.

Betz, C. L., Ferris, M. E., Woodward, J. F., Okumura, M. J., Jan, S., & Wood, D. L. (2014). The health care transition research consortium health care transition model: A framework for research and practice. *Journal of Pediatric Rehabilitation Medicine, 7*(1), 3–15. https://doi.org/10.3233/PRM-140277.

Cantú-Quintanilla, G., Ferris, M., Otero, A., Gutiérrez-Almaraz, A., Valverde-Rosas, S., Velázquez-Jones, L., Luque-Coqui, M., Cohen, S., & Medeiros, M. (2015). Validation of the UNC TRxANSITION scale™ version 3 among Mexican adolescents with chronic kidney disease. *Journal of Pediatric Nursing, 30*(5), e71–e81. https://doi.org/10.1016/j.pedn.2015.06.011.

Cheak-Zamora, N., Petroski, G., La Manna, A., Beversdorf, D., & Farmer, J. (2021). Validation of the health-related Independence for young adults with autism spectrum disorder measure-caregiver version. *Journal of Autism and Developmental Disorders, 51*(6), 2036–2046. https://doi.org/10.1515/jtm-2020-0020.

Cheung, R., Nelson, W., Advincula, L., Cureton, V. Y., & Canham, D. L. (2005). Understanding the culture of Chinese children and families. *The Journal of School Nursing, 21*(1), 3–9. https://doi.org/10.1177/10598405050210010301.

Cohen, S. E., Hooper, S. R., Javalkar, K., Haberman, C., Fenton, N., Lai, H., Mahan, J. D., Massengill, S., Kelly, M., Cantú, G., Medeiros, M., Phillips, A., Sawicki, G., Wood, D., Johnson, M., Benton, M. H., & Ferris, M. (2015). Self-management and transition readiness assessment: Concurrent, predictive and discriminant validation of the $STAR_x$ questionnaire. *Journal of Pediatric Nursing, 30*(5), 668–676. https://doi.org/10.1016/j.pedn.2015.05.006.

Darter, B. J., Rodriguez, K. M., & Wilken, J. M. (2013). Test–retest reliability and minimum detectable change using the k4b2: Oxygen consumption, gait efficiency, and heart rate for healthy adults during submaximal walking. *Research Quarterly for Exercise and Sport, 84*(2), 223–231. https://doi.org/10.1080/02701367.2013.784720.

Dong, Y., Hu, P., Song, Y., Dong, B., Zou, Z., Wang, Z., Xu, R., Luo, D., Gao, D., Wen, B., Ma, Y., Ma, J., Tian, X., Huang, X., Narayan, A., & Patton, G. C. (2020). National and subnational trends in mortality and causes of death in Chinese children and adolescents aged 5–19 years from 1953 to 2016. *Journal of Adolescent Health, 67*(5), S3–S13. https://doi.org/10.1016/j.jadohealth.2020.05.012.

Fenton, N., Ferris, M., Ko, Z., Javalkar, K., & Hooper, S. R. (2015). The relationship of health care transition readiness to disease-related characteristics, psychosocial factors, and health care outcomes: Preliminary findings in adolescents with chronic kidney disease. *Journal of Pediatric Rehabilitation Medicine, 8*(1), 13–22. https://doi.org/10.3233/PRM-150314.

Ferris, M., Cohen, S., Haberman, C., Javalkar, K., Massengill, S., Mahan, J. D., Kim, S., Bickford, K., Cantu, G., Medeiros, M., Phillips, A., Ferris, M. T., & Hooper, S. R. (2015). Self-management and transition readiness assessment: Development, reliability, and factor structure of the $STAR_x$ questionnaire. *Journal of Pediatric Nursing, 30*, 691–699. https://doi.org/10.1016/j.pedn.2015.05.009.

Graham, J. W., Cumsille, P. E., & Shevock, A. E. (2013). Methods for handling missing data. In J. A. Schinka, W. F. Velicer, & I. B. Weiner (Eds.), *Handbook of psychology: Research methods in psychology* (pp. 109–141). John Wiley & Sons, Inc.

Gunzler, D. D., & Morris, N. (2015). A tutorial on structural equation modeling for analysis of overlapping symptoms in co-occurring conditions using MPlus. *Statistics in Medicine, 34*(24), 3246–3280. https://doi.org/10.1002/sim.6541.

Holland, J. E., Varni, S. E., Pulcini, C. D., Simon, T. D., & Harder, V. S. (2022). Assessing the relationship between well-care visit and emergency department utilization among adolescents and young adults. *Journal of Adolescent Health, 70*(1), 64–69. https://doi.org/10.1016/j.jadohealth.2021.08.011.

Huang, H., Wang, Y., Mao, X., Qin, X., & Cheng, L. (2021). Translation and validation of TRANSITION-Q for Chinese pediatric cancer survivors. *Journal of Pediatric Nursing, 61*, 130–135. https://doi.org/10.1016/j.pedn.2021.05.009.

Huang, J., Zhang, M., & Liu, X. (2020). Correlation between patient and visitor violence and workload among public healthcare workers in China: A cross-sectional study. *BMJ Open, 10*(4), Article e034605. https://doi.org/10.1136/bmjopen-2019-034605.

Klassen, A. F., Grant, C., Barr, R., Brill, H., Kraus de Camargo, O., Ronen, G. M., Samaan, M. C., Mondal, T., Cano, S., Schlatman, A., Tsangaris, E., Athale, U., Wickert, N., & Gorter, J. W. (2015). Development and validation of a generic scale for use in transition programmes to measure self-management skills in adolescents with chronic health conditions: The TRANSITION-Q. *Child: Care, Health and Development, 41*(4), 547–558. https://doi.org/10.1111/cch.12207.

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine, 15*(2), 155–163. https://doi.org/10.1016/j.jcm.2016.02.012.

Nazareth, M., Hart, L., Ferris, M., Rak, E., Hooper, S., & van Tilburg, M. A. (2018). A parental report of youth transition readiness: The parent $STAR_x$ questionnaire ($STAR_x$-P) and re-evaluation of the $STAR_x$ child report. *Journal of Pediatric Nursing, 38*, 122–126. https://doi.org/10.1016/j.pedn.2017.08.033.

Parfeniuk, S., Petrovic, K., MacIsaac, P. L., Cook, K. A., & Rempel, G. R. (2020). Transition readiness measures for adolescents and young adults with chronic health conditions: A systematic review. *Journal of Transition Medicine, 2*(1), 20200020. https://doi.org/10.1515/jtm-2020-0020.

Rattray, J., & Jones, M. C. (2007). Essential elements of questionnaire design and development. *Journal of Clinical Nursing, 16*(2), 234–243. https://doi.org/10.1111/j.1365-2702.2006.01573.x.

Sawin, K. J., Margolis, R., Bookman, J. R. M., Bellin, M. H., Logan, L. R., Woodward, J., & Brei, T. J. (2020). Analysis of self-management and transition readiness instruments for clinical practice. In C. L. Betz, & I. T. Coyne (Eds.), *Transition from pediatric to adult healthcare services for adolescents and young adults with long-term conditions* (pp. 71–109). Cham: Springer. https://doi.org/10.1007/978-3-030-23384-6_4.

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research, 99*(6), 323–338. https://doi.org/10.3200/JOER.99.6.323-338.

Sousa, V. D., & Rojjanasrirat, W. (2011). Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: A clear and user-friendly guideline. *Journal of Evaluation in Clinical Practice, 17*(2), 268–274. https://doi.org/10.1111/j.1365-2753.2010.01434.x.

Traino, K. A., Sharkey, C. M., Perez, M. N., Bakula, D. M., Roberts, C. M., Chaney, J. M., & Mullins, L. L. (2021). Health care utilization, transition readiness, and quality of life: A latent class analysis. *Journal of Pediatric Psychology, 46*(2), 197–207. https://doi.org/10.1093/jpepsy/jsaa099.

UNC STARx Program (2021). About the $STAR_x$ questionnaire. https://www.med.unc.edu/transition/transition-tools/trxansition-scale/.

Ware, J. E., Jr., & Gandek, B. (1998). Methods for testing data quality, scaling assumptions, and reliability: The IQOLA project approach. *Journal of Clinical Epidemiology, 51*(11), 945–952.

White, P. H., Cooley, W. C., & American Academy of Pediatrics, & American Academy of Family Physicians (2018). Supporting the health care transition from adolescence to adulthood in the medical home. *Pediatrics, 142*(5) Article e20182587. https://doi.org/10.1542/peds.2018-2587.