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Rasch validation of the Chinese parent–child interaction scale (CPCIS)

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Abstract

Background Proper parent–child interaction is crucial for child development, but an assessment tool in Chinese is currently lacking. This study aimed to develop and validate a parent-reported parent–child interaction scale for Chinese preschool children.

Methods The Chinese parent–child interaction scale (CPCIS) was designed by an expert panel based on the literature and clinical observations in the Chinese context. The initial CPCIS had 14 parent–child interactive activity items. Psychometric properties of the CPCIS were examined using the Rasch model and confirmatory factor analysis (CFA). Convergent validity was investigated by the associations between CPCIS and family income, maternal education level, and children's school readiness.

Results The study recruited 567 Chinese parent–child pairs from diverse socioeconomic backgrounds, who completed the CPCIS. Six out of the 14 items in the initial CPCIS were dropped due to suboptimal fit values. The refined 8-item CPCIS was shown to be valid and reliable by Rasch models and CFA. The person separation reliability and Cronbach's α of the CPCIS were 0.81 and 0.82, respectively. The CPCIS scores were positively associated with family's socioeconomic status ($\eta^2 = 0.05$, $P < 0.001$), maternal education level ($\eta^2 = 0.08$, $P < 0.001$), and children's school readiness ($\eta^2 = 0.01$, $P < 0.01$).

Conclusion CPCIS is an easily administered, valid, and reliable tool for the assessment of parent–child interactions in Chinese families.

Keywords Chinese · Early childhood · Home learning environment · Parent–child interaction · Validation

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Introduction

Family environment plays a central role in a child's health, growth and development, with appropriate parent–child interactions (PCI) being a key determinant of cognitive and psychosocial development [1, 2]. In the past few decades, numerous rating scales have been developed to assess different dimensions of PCI [3], including the emotional availability scales (EAS) [4], National Institute of child health and human development (NICHD) scales [5, 6], the Dyadic parent–child interaction scale [7], the StimQ [8], and the home observation for measurement of the environment (HOME) inventory [9]. However, most of these rating scales are based on direct observations or face-to-face interviews, which make the assessments more time- and resource-consuming. There would also be difficulties to administer these scales in population studies.

In contrast, parent-reported questionnaire should be a more feasible tool for studying PCI in large epidemiological studies. However, the tool needs to be culturally relevant, as

PCI may be culturally dependent [10]. As such a tool is still not available in Chinese population, we, therefore, aimed to develop and validate in this study a parent-reported scale for measuring PCI in Chinese preschool children.

Method

Conceptual framework

The development framework of Chinese parent–child interaction scale (CPCIS) is shown in Fig. 1. Adapting the previous literature, PCI is hypothesized as a core element in the home learning environment [11] to enhance children's health and development. The home learning environment and PCI are determined by social and cultural norm (e.g., whether the culture is in favor of a particular parent–child activity), family characteristics (e.g., parents' education level and resources available), and child characteristics (e.g., physical health of the child). Frequency of parent–child activities, measured by the CPCIS, represents the number of beneficial activities that the parents and the children perform together.

The CPCIS had two subscales: the learning and recreation subscales, which were similar to the academic stimulation and variety subscales in the early childhood HOME inventory [11]. Such design also takes reference to the traditional Chinese culture which values learning and recreation activities very differently [12].

Development of the Chinese parent–child interaction scale (CPCIS)

An expert panel, comprized of developmental pediatricians, researchers in early childhood education, preschool teachers, statisticians, and public health practitioners, was formed to select and review the items to be included in CPCIS. The expert panel selected 14 parent–child activities in the first version of CPCIS based on local observations and literature
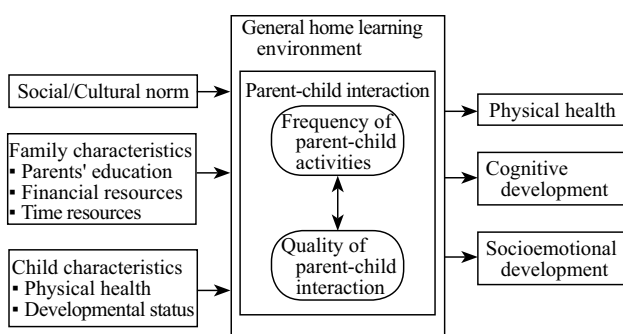
Fig. 1 Conceptual framework of the CPCIS

on PCI and home learning environment, with particular reference to the HOME inventory [11] and Chinese early parental involvement scale (CEPIS) [13]. The frequencies of these 14 activities were scored on a 6-point Likert scale from 0 (*"Almost never or less than once a week"*) to 5 (*"Almost every day of the week"*). Among the 14 items, nine belonged to the recreation activity subscale and five belonged to the learning activity subscale.

Study design and participants

Twenty kindergartens were randomly chosen from two districts in Hong Kong: Hong Kong Island (HKI) and Yuen Long (YL). The district of HKI is a typical affluent area in Hong Kong, whereas YL represents of one of the more disadvantaged districts. In 2012, the median monthly family income in HKI was USD 5141 compared to USD 2776 in YL [14].

With permission of the kindergarten principal, one final year (K3) class was randomly chosen from each of the participating kindergarten. Parents of all the children in selected K3 classes were invited to participate in this study. Written informed consent was obtained from each parent of the participating children. The participating parents completed the first version of the Chinese parent–child interaction scale (CPCIS) and a socioeconomic status (SES) questionnaire. The children's developmental status (school readiness) was assessed by the teacher most familiar with the child using the *Chinese Early Development Instrument*, a standard measurement instrument previously validated among Chinese preschoolers [15].

Rasch model

The CPCIS was validated with the Rasch rating scale model [16] using the *eRm* package in *R* [17]. The Rasch rating scale model adopts the widely accepted theoretical framework for psychological and health-related scales and is directly applicable to ordinal data (e.g., Likert scale data). The Rasch framework assumes a latent difficulty index for each item and an ability score for each individual, which are independent of each other. The difficulty index and ability score are assumed to affect the probability of choosing a particular response. The Rasch model provides a consistent framework for examining a scale's validity and reliability. It is often considered to be a more rigorous validation method than conventional data-referenced psychometric analysis [18]. In this study, the Rasch model was used to refine the initial version of the CPCIS (via removal of unfit items and recoding of item categories) and then used to assess the validity and reliability of the refined scale.

Categories and thresholds

To validate the linearity of the measure, category probability curves were plotted for each item in the scale. For each item, a probability curve was plotted for each category (e.g., 6 curves for the 6-point Likert scale). Each curve represented the probability of choosing that category based on the person's ability. The intersections of the curves were the thresholds for determining the predicted category. A good Rasch scale should have item thresholds ordered according to the category. Recoding was considered when disordering occurred.

Item and person fit

The fit of specific items and individuals was examined by mean squared residuals. A residual is the difference between the predicted category in the Rasch model and the observed category. Both the outfit (outlier-sensitive) and the infit (inlier pattern-sensitive) mean squared residuals were used, the former is more sensitive for detecting rare extremes and the latter is more sensitive for detecting irregular patterns [19]. Ideally, both the infit and outfit statistics should be close to the value of 1.0; a smaller value would suggest a tendency to overfit (i.e., the item may not provide any extra information) and a larger value would suggest a tendency to underfit (i.e., the item may distort the outcome measures). We consider infit and outfit values between 0.8 and 1.2 to be good and those between 0.5 and 1.5 to be acceptable [19].

Differential item functioning

The overall Rasch model fit was tested using the concept of differential item function (DIF). DIF occurs if individuals perform differently even if their underlying abilities are the same [20]. In this study, we used the Andersen's likelihood ratio test [20] to examine whether DIF existed across the gender of children and residential districts (i.e., by splitting the dataset according to gender and residential district), because we believe the tool should be applicable regardless of gender and SES.

Unidimensionality

The Rasch model is a unidimensional measurement model. Although the CPCIS was designed to have two subscales (learning and recreation activity subscales), both compose of PCI items and therefore should still follow the unidimensionality [21]. To test for such an assumption, we first examined the proportion of variance explained by the rating scale model, and then applied principal component analysis of residuals (PCAR) [22]. If the proportion of variance explained by the rating scale model is greater than 50% and the first eigenvalue is less than 1.40, then this would indicate the Rasch scale fulfills the unidimensionality assumption [23].

Reliability

The internal reliability of the scale was estimated using Cronbach's α, with values above 0.70 as acceptable and values above 0.80 as good [24]. The person separation reliability (PSR) index was also calculated, which measures how well the scale can separate the participants according to their underlying abilities. The acceptable values of PSR were similar to that of Cronbach's α [24].

Construct validity

In addition to the Rasch analysis, the construct validity of the CPCIS was also tested using second-order confirmatory factor analysis (CFA) to ensure the theoretical structure of the scale. A comparative fit index (CFI) of at least 0.96, a root mean square error of approximation (RMSEA) less than 0.06, and a standardized root mean square residual (SRMR) of less than 0.09 were considered to be indicative of a good fit [25].

Convergent validity

As an external validation, the associations of CPCIS with family income (categorized using tertiles), maternal education level, and school readiness were examined using analysis of variance (ANOVA) models. Information on family income and maternal education level were directly reported by the parents in the family SES questionnaire. Maternal education has been found to be one of the most reliable indicators of family's socioeconomic status in local children studies [26]. The school readiness of participating children was assessed by the kindergarten teacher most familiar with the child using the Chinese early development instrument (CEDI). The CEDI was previously validated among Chinese preschool children and is based on the early development instrument, a widely used developmental tool for assessing school readiness of preschool children [27]. The CEDI covers five different dimensions of holistic child development including: (1) physical health and well-being, (2) social competence, (3) emotional maturity, (4) language and cognitive development, and (5) communication skills and general knowledge [15].

ANOVA F-test was used to analyze the associations, and the corresponding effect sizes (η^2) were then calculated. Effect sizes of 0.01, 0.06, and 0.14 were categorized as small, medium, and large, respectively [28]. For validation of the CPCIS measure, we expect CPCIS to

have positive associations with family income, maternal education, and the child's school readiness.

Ethics approval

The study was approved by the ethical committee of the Institutional Review Board of the University of Hong Kong. Informed written consent was obtained from the parents of each participant. Study procedure was carried out in accordance with the approved guidelines.

Results

Participant characteristics

A total of 567 parents of preschool children (aged 4–6 years; 52.1% females) agreed to participate in this study. Parents completed the CPCIS (the first version of CPCIS containing 14 items) and the family SES questionnaire. The median monthly family income of the participants was USD 4499. About one-third (33.2%) of the participating mothers had at least one bachelor's degree.

Category ordering

The Rasch analysis showed category disordering in the category probability curves of the CPCIS (Supplementary Fig. 1), which were recoded as follows: 0 ("*Almost never or less than once a week*"), 1 ('*Once a week*'), 2 ('*Twice to three times a week*'), and 3 ('*Four times or more a week*'). The category probability curves and the thresholds displayed desirable characteristics after recoding (Supplementary Fig. 2).

Refinement and fit of CPCIS

Six PCI items (going to library, watching TV programs, handcrafting, playing and exercising, letting children to do housework, and discussing science; Table 1) were dropped from the initial 14-item CPCIS due to unacceptable infit and/or outfit values, resulting in a final 8-item CPCIS. After refitting the model, all of the remaining items showed acceptable infit and outfit values, and no misfits were detected by Wald tests (Table 2). All items, except 'teaching Chinese characters', exhibited good infit and outfit values (ranging from 0.83 to 1.07). The 'teaching Chinese characters' showed a tendency to overfit (infit = 0.63, outfit = 0.65), indicating that this item might not be very efficient in providing

Table 1 Development and descriptive statistics of the CPCIS

Variables	Initial number of items	Number of items excluded	Number of items in the final scale	Mean (SD)	Cronbach's α	Correlation with recreation activity
Recreation activity	9	4	5	2.7 (1.3)	0.71	0.59*
Learning activity	5	2	3	3.1 (1.5)	0.78	–
Overall	14	6	8	2.9 (1.3)	0.82	–

*$P < 0.001$

Table 2 Rasch analysis of individual items and descriptive statistics of the final scales

Variables	Difficulty parameter	χ^2	P	Outfit	Infit
Recreation activity					
Reading	0[a]	428.6	1.00	0.83	0.80
Drawing	0.22	509.7	0.57	0.99	0.96
Singing	0.17	540.0	0.23	1.04	1.04
Storytelling	− 0.26	496.3	0.73	0.96	0.97
Discussing news and current affairs	0.97	551.8	0.13	1.07	1.07
Learning activity					
Arithmetic and mathematics	0.27	462.3	0.96	0.89	0.86
English alphabet	− 0.27	429.7	1.00	0.83	0.84
Chinese characters	− 0.71	337.1	1.00	0.65	0.63

[a] Reference group in difficulty parameter estimation

additional information. The difficulty parameter of the item "reading with the child" was set to 0 as the reference value. The most difficult item was 'discussing news and current affairs', whereas the easiest item was 'teaching Chinese characters'.

Differential item functioning and unidimensionality

Andersen's likelihood ratio test did not detect any differences in the CPCIS between gender of the child ($P = 0.21$) and the residential district ($P = 0.11$) after controlling for their latent PCI scores. The Rasch rating scale model explained 62.0% of the raw variance with an eigenvalue of 1.28, indicating no evidence for rejection of the unidimensionality assumption.

Reliability

The two subscales achieved acceptable internal reliabilities (Cronbach's $\alpha > 0.70$) and the overall scale achieved good internal reliability (Cronbach's $\alpha = 0.82$). The Rasch model PSR was 0.81, indicating good reliability in separating persons according to their PCI level.

Construct validity

The CFA of the final CPCIS had a CFI of 0.99, TFI of 0.98, RMSEA of 0.04 (95% CI 0.02–0.06), and SRMR of 0.02 indicating good model fit (Fig. 2). The latent PCI score was estimated to be the sum of both recreation and learning activity subscales. The item loadings of both subscales were close to 1.00, showing that there was no indication for differential loading.
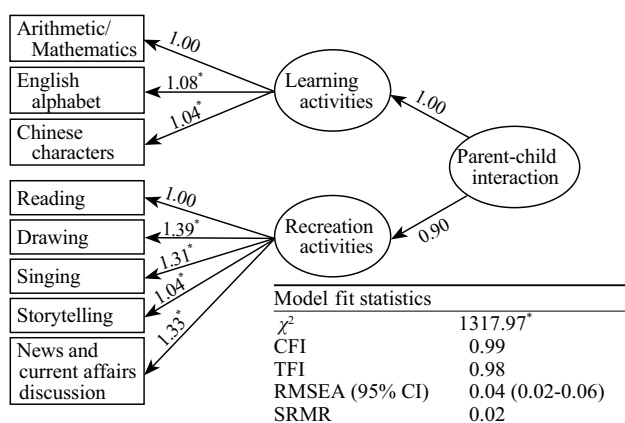
Fig. 2 Confirmatory factor analysis of the CPCIS. *$P < 0.001$

Convergent validity

The associations between SES and CPCIS score are shown in Fig. 3a and b. Both the monthly family income and maternal education level appeared to have positive linear relationships with CPCIS scores ($P < 0.001$). The effect size of income on CPCIS was 0.05 and that of maternal education level was 0.08. Meanwhile, there was also a significant gradient relationship between CPCIS and school readiness ($P < 0.01$) as shown in Fig. 3c. A higher CPCIS score was significantly associated with better school readiness (effect size of 0.01).

Discussion

Strengths of the CPCIS

The current study examined the psychometric properties of the parent-reported CPCIS using Rasch models and standard validation methods. The final CPCIS scale contained eight items that were found to have good construct validity, convergent validity, internal consistency, and person separation reliability. The CPCIS appears to be a useful assessment tool for assessing parent–child interaction in population study, as the tool has good validity and reliability and could be easily completed by study participants (Fig. 3).

Many of the conventional measures of PCI are based on direct observations or face-to-face interviews, which limited their applicability [29]. Some of them need to be conducted in controlled laboratory settings, with parents and children being aware that they are being observed [30], which may influence how natural the parent–child interactive activities were conducted. Second, even if parents and children acted as though they were in a natural home environment, these measurements could only capture PCI in a small period of time, which may not necessarily reflect the PCI in daily life [30]. Third, direct observation methods might not be feasible in large-scale population surveys or cohort studies with repeated measurements. A well-trained researcher is required to observe and code the PCIs in each parent–child pair for at least half an hour, which would be impractical for large-scale studies, as substantial resources would be needed to conduct such assessments.

On the other hand, previous parent-reported measures such as the Chinese Early Parental Involvement Scale (CEPIS) were shown to be reliable in measuring certain dimensions of PCI [13]. Although CEPIS is not a measurement tool specifically for parent–child interaction, its 'Language and Cognitive Activities' subscale has some
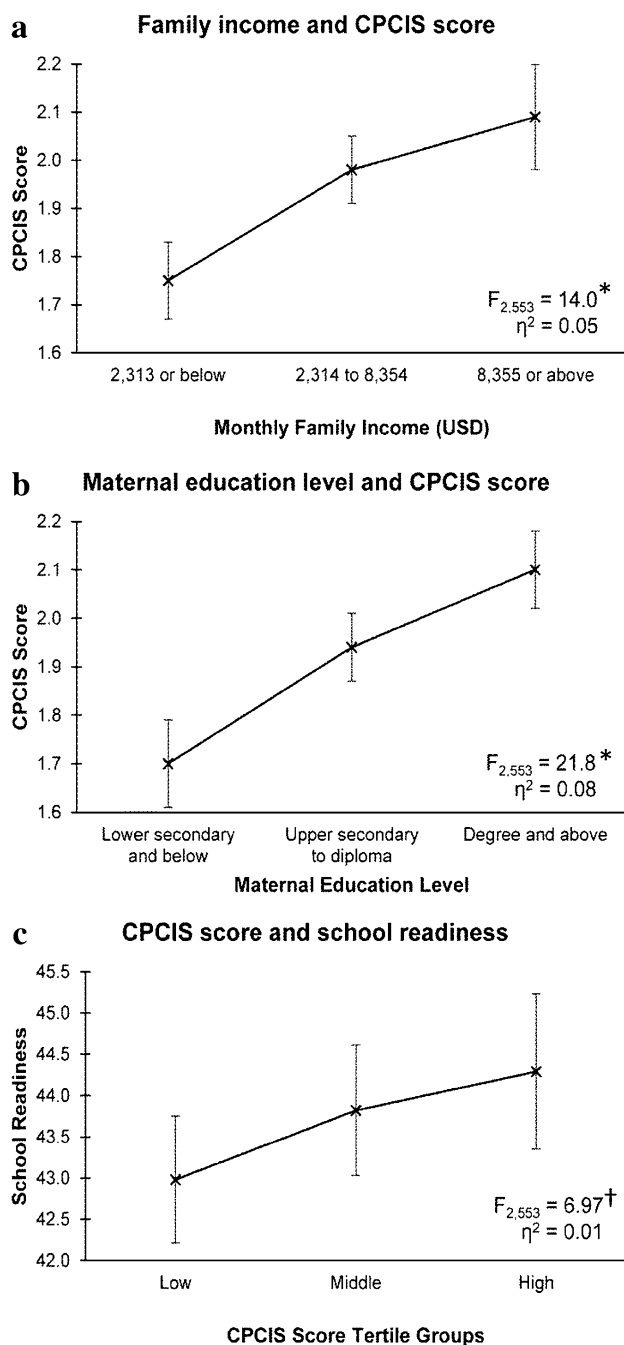
Fig. 3 Association between CPCIS score, family income, maternal education level, and school readiness. *$P < 0.001$; †$P < 0.01$

similarities with the present CPCIS, and lends support for its usefulness and applicability. This subscale had acceptable internal reliability (Cronbach's $\alpha = 0.76$) and was correlated with school readiness among Chinese preschoolers with a small to medium effect size ($\beta = 0.24$). The revised version of the CPCIS containing eight items achieved good reliability and had a moderate association with school readiness.

Interpretation of CPCIS and its subscales

The CPCIS scale has two subscales measuring recreation and learning activities. The Recreation Activity subscale included items on reading, drawing, singing, storytelling, and discussing news and current affairs. Even though children can learn through these activities, knowledge transfer is not the primary purpose. This subscale represents a set of activities that are fun-based and interactive. The learning activity subscale focused on teaching and learning activities between parents and children. This subscale covered the three areas of mathematics, Chinese, and English language, which are considered to be core subjects in the Hong Kong and Chinese schooling system.

Although both the recreation-based and learning-based activities in these two subscales could stimulate child development and promote family bonding between parents and children [31, 32], they represented different approaches. Learning activities are often more formal and serious, whereas recreation activities are more casual and interesting. In traditional Chinese teachings and beliefs, play or recreation is often regarded as being detrimental to children, whereas serious study is regarded as being beneficial [10]. Therefore, it would be of interest to separate these two sub-dimensions of PCI and study how each of them is associated with child development. In fact, the data collected in this study supported such an interpretation. Although the two subscales had significant correlation with each other, the Pearson's correlation coefficient was found to have only a moderate effect size [28]. This indicates that learning- and recreation-related activities were both subtypes of PCI, but there are certain differences between them. Nevertheless, we should note that the CPCIS still passed the unidimensional test. This could be understood with the following metaphor [21]. In a mathematics test, there are questions on both addition and subtraction (i.e., two subscales), which represent two sub-dimensions of arithmetic abilities. Since the overall test score still measures the general arithmetic ability, the overall test score should still be considered as unidimensional with subscales hierarchically nested under [21]. Such a premise was explicitly modeled and tested by the second-order CFA, which achieved excellent fit indices and verified our hypothesis.

The Rasch analysis showed a wide range of relative difficulty parameters in the eight items ranging from -0.71 to 0.97, which indicated that CPCIS would have sufficient discriminating power to distinguish levels of PCI in a highly diverse population. For example, even among parents who were not good at or too busy to interact with their children, CPCIS could differentiate between parents in terms of 'Teaching Chinese characters' and 'Storytelling' items. These activities are relatively easy and common

among the whole population, and it would be very useful to understand the extent of such activities at the lower end of the PCI spectrum. Similarly, the items with high relative difficulty could be useful to separate parents who were good at engaging in stimulating activities with their children, such as discussing the news and current affairs, teaching mathematics, and drawing together.

The items in the original CPCIS were scored on six categories to capture accurately the PCI frequency ranging from 0 ('*Almost none or less than once a week*') to 5 ('*Almost every day in a week*'). However, the Rasch analysis of the category thresholds showed that parents may not be able to distinguish between the third ("*2 times a week*") and fourth ('*3 times a week*') categories or the fifth ('*4 to 5 times a week*') and sixth ('*Almost every day of the week*') categories, which reduced the reliability of the scale. Such difficulties in recalling the frequency accurately could cause over- or under-estimations due to their own perceptions [33]. One solution to this problem was to covert the Likert-style items into a diary-type reporting system similar to that used in a food diary [34], which would allow parents to record the exact number of PCI activities daily. Nevertheless, this was not adopted in this study, as the daily record would induce heavy burden to the parents. After recoding of the disordered options, the overall reliability improved and the category probability curves also displayed appropriate traits.

PCI and SES

Both family income and maternal education level were found to have significant positive associations with the CPCIS scores. This was consistent with previous findings on the relationship between parent–child interactions and family's socioeconomic status [35], although more evidence is needed to confirm the causality. Our preliminary evidence on the association between PCI and SES suggests the need to promote PCI among underprivileged families.

SES may influence PCI through various mechanisms. First and foremost, parents with lower education level often have less knowledge towards PCI (e.g., not understanding the importance of PCI in child development) and lower educational expectations regarding their children [36]. Both of these would significantly reduce the parents' intention in spending time on interacting with their children [36]. Furthermore, even for parents who intent to interact with the children, lower family income would limit the resources and time which can be spent to achieve high-quality parent–child interactions. It is not uncommon for both parents from poor families having long working hours, which adversely affects the quality of child care and PCI [37, 38]. Future intervention studies should put effort on these pathways to promote better PCI among lower SES families.

PCI and child development

Previous evidence already demonstrated a relationship between child development and PCI using direct observation scales such as the HOME measurement [11]. However, such an association between child development and PCI using parent-reported scales has been less reported [29]. It was argued that such scales would be prone to recall and/or report bias of the parents. Nevertheless, our CPCIS was found to have moderately sized associations with school readiness among preschool children. Our study showed that CPCIS is a reliable assessment tool to measure PCI in child development studies.

The current study should be interpreted with the following caveats. First, the study recruited participants from only two districts in Hong Kong and so the findings may not be representative of the whole population. However, the two districts represented a wide spectrum of socioeconomic backgrounds and the children came from both wealthy and poor families. The family income and maternal education appeared to be evenly distributed across the participating families indicating a sufficient representative sample. Second, this was a cross-sectional study, so the predictive validity of CPCIS on child development might not have been properly assessed. Future studies should consider the potential effects of PCI during preschool years on the long-term cognitive outcomes and academic achievements of children. Third, no concurrent gold standard measurement of PCI was used in this study as an external validation of CPCIS, because a reliable PCI assessment tool for the Chinese population is still lacking. Instead, we validated the CPCIS using the Rasch model, and compared the CPCIS scores to both family SES and children's school readiness. Finally, the CPCIS mainly captured the quantity of PCI and not much on the quality. Having said that, studies have also shown that the quality and quantity of PCIs are often correlated [39].

In conclusion, this study demonstrated that CPCIS has good psychometric properties and is a valid and reliable tool for assessing PCI among Chinese preschool children and their parents. The tool is practical and can be easily administered in population-based studies, because of its parent-reported nature and brevity. Future studies should focus more on the relationship between PCI and the different dimensions of child development. It would also be important to study the influence of parent–child interactions on long-term child development and whether such influence varies in different cultural contexts [11].

Mr. Wong and Dr. Chow assisted study design, interpreted the data, and critically revised the manuscript. All authors approved the final manuscript as submitted.

Compliance with ethical standards

Ethical approval The study was approved by the ethical committee of the Institutional Review Board of the University of Hong Kong. Informed written consent was obtained from the parents of each participant. Study procedure was carried out in accordance with the approved guidelines.

Conflict of interest No financial or non-financial benefits have been received or will be received from any party related directly or indirectly to the subject of this article.

References

1. Ronfani L, Brumatti LV, Mariuz M, Tognin V, Bin M, Ferluga V, et al. The complex interaction between home environment, socioeconomic status, maternal iq and early child neurocognitive development: a multivariate analysis of data collected in a newborn cohort study. PLoS ONE. 2015;10:e0127052.
2. Moss E, Rousseau D, Parent S, St-Laurent D, Saintonge J. Correlates of attachment at school age: maternal reported stress, mother-child interaction, and behavior problems. Child Dev. 1998;69:1390–405.
3. Nieuwesteeg AM, Pouwer F, van Bakel HJ, Emons WH, Aanstoot HJ, Odink R, et al. Quality of the parent-child interaction in young children with type 1 diabetes mellitus: study protocol. BMC Pediatr. 2011;11:28.
4. Biringen Z, Easterbrooks MA. Emotional availability: concept, research, and window on developmental psychopathology. Dev Psychopathol. 2012;24:1–8.
5. Jaeger E. Child care and mother-child interaction in the first 3 years of life. NICHD early child care research network. Dev Psychol. 1999;35:1399–413.
6. Nieuwesteeg A, Hartman E, Pouwer F, Emons W, Aanstoot HJ, Van Mil E, et al. Qualitative observation instrument to measure the quality of parent-child interactions in young children with type 1 diabetes mellitus. BMC Pediatr. 2014;14:145.
7. Robinson EA, Eyberg SM. The dyadic parent-child interaction coding system: standardization and validation. J Consult Clin Psychol. 1981;49:245–50.
8. Mendelsohn A, Dreyer B, Tamis-LeMonda C, Ahuja P. Validity of StimQ, a scale for assessing the cognitive home environment. J Dev Behav Pediatr. 1999;20:399.
9. Burston A, Puckering C, Kearney E. At HOME in Scotland: validation of the home observation for measurement of the environment inventory. Child Care Health Dev. 2005;31:533–8.
10. Lee WO. The cultural context for Chinese learners: conceptions of learning in the confucian tradition. In: Watkins DA, Biggs JB, editors. The Chinese learner: Cultural, psychological and contextual influences. Hong Kong: Comparative
11. Totsika V, Sylva K. The home observation for measurement of the environment revisited. Child Adolesc Ment Health. 2004;9:25–35.
12. Rao N, Ng SS, Sun J. Early learning experiences of young Chinese learners in Hong Kong: the role of traditional values and changing educational policy. In: King RB, Bernardo ABI, editors. The psychology of asian learners. Dordrecht: Springer; 2016. p. 635–49.
13. Lau EYH, Li H, Rao N. Exploring parental involvement in early years education in China: development and validation of the Chinese early parental involvement scale (CEPIS). Int J Early Years Educ. 2012;20:405–21.
14. Hong Kong Census and Statistics Department. Population and household statistics analysed by district council district. Hong Kong: Census and Statistics Department; 2012.
15. Ip P, Li SL, Rao N, Ng SS, Lau WW, Chow CB. Validation study of the Chinese early development instrument (CEDI). BMC Pediatr. 2013;13:146.
16. Wright BD, Masters GN. Rating scale analysis. Chicago: Mesa Press; 1982.
17. Mair P, Hatzinger R. Extended Rasch modeling: the eRm package for the application of IRT models in R. J Stat Softw. 2007;20:1.
18. Tesio L. Measurement in clinical vs. biological medicine: the Rasch model as a bridge on a widening gap. J Appl Meas. 2004;5:362–6.
19. Wright BD, Linacre JM, Gustafson J, Martin-Lof P. Reasonable mean-square fit values. Rasch Meas Trans. 1994;8:370.
20. Mair P, Hatzinger R. CML based estimation of extended Rasch models with the eRm package in R. Psychol Sci. 2007;49:26.
21. Linacre JM. Unidimensional models in a multidimensional world. Rasch Meas Trans. 2009;23:1209.
22. Smith EV Jr. Understanding Rasch measurement: detecting and evaluating the impact of multidimensionality using item fit statistics and principal component analysis of residuals. J Appl Meas. 2002;3:205–31.
23. Smith RM, Miao CY. Assessing unidimensionality for Rasch measurement. In: Wilson M, editor. Objective measurement: theory into practice. Greenwich: Ablex; 1994.
24. Wright BD, Stone MH. Measurement essentials. Wilmington: Wide Range; 1999.
25. Hooper D, Coughlan J, Mullen MR. Structural equation modelling: guidelines for determining model fit. Electron J Bus Res Methods. 2008;6:53–60.
26. Kwok MK, Schooling CM, Lam TH, Leung GM. Does breastfeeding protect against childhood overweight? Hong Kong's "Children of 1997" birth cohort. Int J Epidemiol. 2010;39:297–305.
27. Janus M, Offord DR. Development and psychometric properties of the early development instrument (EDI): a measure of children's school readiness. Can J Behav Sci. 2007;39:1–22.
28. Cohen J. Statistical power analysis for the behavioral sciences Hillsdale. New Jersey: Lawrence Erlbaum Associates; 1988.
29. Aspland H, Gardner F. Observational measures of parent-child interaction: an introductory review. Child Adolesc Ment Health. 2003;8:136–43.
30. Lytton H. Observation studies of parent-child interaction: a methodological review. Child Dev. 1971;42:651–84.
31. Dodici BJ, Draper DC, Peterson CA. Early parent–child interactions and early literacy development. Top Early Child Spec. 2003;23:124–36.
32. Ginsburg KR. The importance of play in promoting healthy child development and maintaining strong parent–child bonds. Pediatrics. 2007;119:182–91.
33. Mathews A, Bradle B. Mood and the self-reference bias in recall. Behav Res Ther. 1983;21:233–9.
34. Brunner E, Juneja M, Marmot M. Dietary assessment in Whitehall II: comparison of 7 days diet diary and food-frequency

Education Research Centre and Australian Council of Educational Research; 1996. p. 63–7.

questionnaire and validity against biomarkers. Br J Nutr. 2001;86:405–14.

35. Dodge KA, Pettit GS, Bates JE. Socialization mediators of the relation between socioeconomic status and child conduct problems. Child Dev. 1994;65:649–65.

36. Davis-Kean PE. The influence of parent education and family income on child achievement: the indirect role of parental expectations and the home environment. J Fam Psychol. 2005;19:294.

37. O'Brien M. Shared caring: bringing fathers into the frame. Manchester: Equal Opportunities Commission; 2005.

38. Gornick JC, Heron A. The regulation of working time as work-family reconciliation policy: comparing Europe, Japan, and the United States. J Comp Policy Analysis. 2006;8:149–66.

39. Booth CL, Clarke-Stewart KA, Vandell DL, McCartney K, Owen MT. Child care usage and mother-infant "quality time". J Marriage Fam. 2002;64:16–26.