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Reliability and Validity of Family Affluence Scale (FAS II) among Adolescents in Beijing, China

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Abstract This study comprises two sub-studies. Study I assessed the test-retest reliability of Family Affluence Scale (FAS II) items among 95 students aged 11 and 15 years old in Beijing. Study II investigated the completion rate of traditional indicators (parents' educational level, perceived family wealth, resident area, and school location) measuring socioeconomic status (SES) compared with FAS II, and examined the internal reliability, external and construct validity of the FAS II items in a population of 5876 schoolchildren aged 11, 13 and 15 years old in Beijing. Our study found that the FAS II items have high completion rates (> 99%) which are better than other SES indicators. Analyses of reliability showed a moderate internal reliability (Cronbach's alpha = 0.58) and at least substantial test-retest reliability (ICC > 0.75). Moderate external validity of FAS II was found by Spearman rank correlation between FAS II and other SES indicators (parental education level and perceived family wealth) (r_s = 0.48-0.51, $p < 0.001$) and ordinal regressions. Graphical log-linear Rasch model (GLLRM) showed that FAS has adequate construct validity (few LD and weak DIF). In conclusion, the FAS II is a reliable and valid SES measure for adolescents in the Beijing area.

Keywords *Adolescents, Family Affluence Scale, Health Behaviour in School-aged Children (HBSC), Reliability, Socioeconomic inequality, Validity*

1 Introduction

Social inequalities in health have been an important research topic in both social science and medicine (Dalstra et al. 2006; Marmot 2005). Research on the association of social inequalities and health behaviour also revealed that socio-economic status plays a role in the explanation of the variant prevalence of the health behaviour (Ritterman et al. 2009). Moreover, health inequalities in young children and adults are well-established, but there has been debate about health inequalities in adolescents (West and Sweeting 2004). Inconsistent or non-associations have been found between socioeconomic status (SES) and some health outcomes among adolescents (Goodman 1999; Goodman 2001; Starfield et al. 2002; West 1997; West and Sweeting 2004). Despite the genuine relationships of SES and health outcomes, the results and findings vary according to sample age groups and research methods, one possible reason for this is that various measures of SES were employed and therefore exert different effects on the same health outcome (Currie et al. 2008), and there might not be sufficient indicators to measure SES of adolescents specifically (Boyce et al. 2006). In the last two decades, the Chinese economy has grown rapidly, resulting in the achievement of improving people's health as well as improving health care. However, these health developments did not automatically follow the economic growth. In actuality, a widening gap in both health status and health care between different social economic statuses was found more often in China (Li and Zhu 2006; Liu et al. 1999). Thus, it is crucially important to develop reliable and valid indicators to measuring SES in China in order to get an accurate picture of the evidence-based results of socio-inequalities in health.

For an adult population, SES is traditionally assessed by education, occupation and income (Ostrove and Adler 1998). Adolescents, normally, are in the period of spending most of their time studying in school and not legally allowed to work, so they do not have any, or have very little economic resources themselves. Accordingly, adolescents' SES is usually measured by using the information of their parents' SES, such as parents' education and occupation, and household income. However, one should be aware of the difficulties of measuring adolescents' SES when using their parental SES as a proxy. As Currie and her colleagues (2008) argued conceptually, it is still uncertain whether parents' SES should be used as a proxy. For instance, the adolescents' SES are not always reflecting their parental SES, and even if it does so, which is the most relevant aspect of SES. Furthermore, methodologically there are also difficulties in obtaining accurate information regarding parental SES from adolescents due to the lack of knowledge or unwillingness to reveal the relevant information (Currie et al. 2008) which results in the low completion or high non-response rates when collecting data of adolescents self-reported parental SES (Molcho et al. 2007, Wardle et al. 2002). In addition, it has been reported that there is a higher non-response rate for those adolescents in the low SES group (Wardle et al. 2004). Therefore, when measuring the SES of adolescents, it is crucially important to formulate accurate and effective indicators, which are easy for adolescents to answer and minimize the potential bias in a certain subgroup.

Among the indicators used for measuring adolescents' SES, the Health Behaviour in School-Aged Children (HBSC) Family Affluence Scale (FAS) is a measure which has recently been developed and widely used to address the

association of SES and health outcomes in both domestically and internationally comparative studies (Currie et al. 2008; Maes et al. 2006; Pickett et al. 2005; Torsheim et al. 2004; Torsheim et al. 2006). The FAS used in the HBSC survey contains several items which assess the SES of the adolescent based on the material condition of their household, which was originally based on the work of Carstairs and Morris (1991) and Townsend (1987). In the 1997/1998 HBSC survey, three FAS items were employed, which asked about family car ownership, the child's use of their own bedroom, and the number of family holidays, referred to as the first version of FAS (FAS I) (Currie et al. 2004). Later, in the 2001/2002 HBSC survey, an item on number of family computers was added and these four FAS items was named as the second version of FAS (FAS II) (Currie et al. 2004).

The FAS II has been used extensively in the HBSC study in the past decade to examine and describe socioeconomic inequalities in relation to adolescent health outcomes. Compared to the traditional SES indicators, one advantage of the FAS II items is that it can greatly reduce the non-response rate. It has been reported that the FAS II items showed a higher completion rate than items on parental education and occupation (Boudreau and Poulin 2009; Lin 2011; Molcho et al. 2007). Validation studies of the FAS II have been done in many HBSC member countries as well as some non-HBSC member countries, from which the results showed that the FAS II items have a moderate internal reliability (Lin 2011; Molcho et al. 2007; Wardle et al. 2002), a significant association with parental education and occupation (Currie et al. 1997; Molcho et al. 2007), a high agreement rate between adolescents and parents (Andersen et al. 2008), and a satisfactory correlation with the national wealth indicator, Gross Domestic Product (GDP) (Boyce et al. 2006). Although the test-retest reliability of FAS II items has not been examined, the rather higher agreement can be predicted due to the objectivity and stability of the indicators (Currie et al. 2008). Moreover, Schnohr and her colleagues (2008) have analyzed the differential item functioning (DIF) of FAS II and demonstrated that it can be used as an interval scale and a measure of wealth within a country and between countries.

The FAS II has also recently been used as a SES indicator outside the context of the HBSC study (e.g. West and Sweeting 2004) or in countries which are not a member of the HBSC network (e.g. Cho and Khang 2010). Because every country has its own culture and economic status, the FAS II should be used after examining the applicability and validity in a certain context. However, since the HBSC study is limited at the moment to countries in Europe and North America, few studies assessing the use of the FAS II have been done elsewhere in the world. To the authors' knowledge, there are only two studies which have been done recently to assess the use of FAS II in Asia (Cho and Khang 2010; Lin 2011) and no similar study has been done in the mainland China. The purposes of this study are, therefore, to investigate the completion rate of the traditional indicators measuring SES compared with FAS II, and to examine the reliability and validity of the FAS II items in a Chinese adolescent population.

2 Methods

This paper comprises data from two separate studies conducted by the China Institute of Sport Science (CISS) in the Beijing area, both following the HBSC research protocol (Currie et al. 2001). Beijing is the capital of China, consisting of

16 districts and 2 counties, with the total population 16.95 million by the end of 2009. Beijing has 653255 students in 1104 primary schools and 508327 students in 634 secondary and upper secondary schools (Beijing Municipal Bureau of Statistics 2010). In 2010, the average annual income in Beijing was 29073 Chinese Yuan (around 4419$) per person, which is approximately 1.2 times the average annual income for China (3633$) (Beijing Municipal Bureau of Statistics 2010).

2.1 Study I. Test-retest reliability study

The data for test-retest reliability analysis was from the pilot study for the HBSC based behaviour and lifestyle survey for school-aged children in Beijing in October 2008. A sample of 95 male and female students aged 11 or 15 years old participated in a test and retest with a three weeks interval (the demographic characteristics of respondents can be seen in Table 1). Student identity numbers of respondents were utilized to permit matching of test-retest questionnaires. The test-retest reliability of FAS II items was estimated with the single measure of Intraclass Correlation Coefficients (ICC) (Shrout and Fleiss 1979) through case 2 (using a two-way random model with an absolute agreement type), with 95% confidence interval (CI). The detailed information of Study I is described elsewhere (Liu et al. 2010).

2.2 Study II. Internal reliability and validity study

2.2.1 Study subjects

The data for all the other analyses were from the HBSC based behaviour and lifestyle survey for school-aged children in Beijing, which was carried out between November and December 2008 by the China Institute of Sport Science (CISS). The survey sampled from state schools all over the Beijing area. The Chinese school and class systems are not widely known in western countries: sometimes students in the schools, and even in the classes of a school, are arranged according to geographic location, academic achievement etc. Therefore, in order to effectively choose the most representative sample, the survey sampling included three stages and two strata that introduced the detail as follows:

Stage I. Selection of the sample districts (counties)

The stratified random sample method was used in this stage. The first step of this stage was to stratify all the 16 districts and 2 counties of Beijing area according to geographical location. Two strata, urban area and rural area were stratified in this step. The second step was to stratify both the urban and rural areas in terms of social economic development level. Three strata, good, fair and poor, were used. The last step of this stage was to choose one district (county) randomly from each level in both urban and rural areas.

Stage II. Selection of the sample schools

The stratified random sample method was used in this stage. Firstly, all schools in each sample district (county) were divided into three categories on the basis of school conditions (good, fair and poor). Then, one primary school, one secondary school and one upper secondary school were

selected randomly from each category in each sample district (county). In order to ensure the convenience of the survey, both the secondary school and the upper secondary school could be drawn from the same high school which includes both secondary and upper secondary school.

Stage III. Selection of the sample classes

The random sampling method or stratified random sampling method is used in this stage.

A total of 5985 schoolchildren were sampled following the above mentioned three stages. Samples were cleaned in line with the cleaning rule of the HBSC survey protocol if their gender or birth date were missing, or their age was beyond the target range (Currie et al. 2001). The final data used for analyses contained a total of 5876 schoolchildren, making a completion rate of 98.2% (the demographic characteristics of respondents can be seen from Table 1).

Table 1 Demographic characteristics of respondents in Study I and Study II

	Sample size		Age	
	n	%	Mean age	SD
Study I				
Total	95	100.0	/	/
Boys	51	53.7	/	/
Girls	44	46.3	/	/
11yrs	44	46.3	11.70	0.35
15yrs	51	53.7	15.80	0.32
Study II				
Total	5876	100.0	/	/
Boys	2816	47.9	/	/
Girls	3060	52.1	/	/
11yrs	1941	33.0	11.74	0.32
13yrs	1930	32.8	13.73	0.34
15yrs	2005	34.1	15.78	0.32

2.2.2 Survey procedure

All students in the selected sample class were asked to complete a self-report questionnaire during a normal school class with a teacher and/or researcher administering. The students were first instructed how to fill in the questionnaire. Student's participation in the survey was voluntary and the questionnaire could only be accessed by researcher. Students were also informed that only the researcher will read their answers. The questionnaire used in the Chinese survey was based on the English version of the questionnaire used in the Finnish HBSC Survey in 2006. The questionnaire was firstly translated from English to Chinese by two researchers independently and re-translated from Chinese to English by other professional translators to check for any discrepancies. Both studies mentioned here were approved by the ethics committee of CISS and the Research Centre for Health Promotion at the University of Jyväskylä.

2.2.3 Variables used in analysis

Family Affluence Scale II

The FAS II was used as a measure of SES in this study. The items, response categories, codes and analyses strategy of FAS II used in the present study are the following:

- "Does your family own a car, van or truck?"
  Response categories were: No (= 0); Yes, one (= 1); Yes, two or more (= 2).
- "Do you have your own bedroom for yourself?"
  Response categories were: No (= 0); Yes (= 1).
- "During the past 12 months, how many times did you travel away on holiday with your family?"
  Response categories were: Not at all (= 0); Once (= 1); Twice (= 2); More than twice (= 3).
- "How many computers does your family own?"
  Response categories were: None (= 0); One (= 1); Two (= 2); More than two (= 3).

According to Currie and her colleagues (2008), a composite FAS score was calculated for each respondent based on his or her answers to these four items. Following previous HBSC surveys, the two highest response categories ('2' and '3 or more') of the last two items (holidays and computers) were combined. Three groups were categorized in terms of the composite FAS score, in which FAS low (score = 0–3) indicated low affluence, FAS medium (score = 4, 5) indicated middle affluence, and FAS high (score = 6, 7) indicated high affluence.

Parents' educational level

Students were asked to choose their father's and mother's highest level of education from 7 alternatives, which are under primary school, primary school, secondary school, upper secondary school, junior college, university (bachelor level), and graduate or more. During the analyses, the parents' education were divided into three categories, low education level (under the primary school, primary school, secondary school), medium education level (upper second school, junior college), and high education level (university, graduate or more), for father and mother respectively.

Perceived Family Wealth

Perceived socioeconomic status of the household was enquired by asking the students' own perception of their family financial situation. The responses were very well off financially, quite well off financially, average, not very well off financially and not at all well off financially. The indicator of perceived family wealth was divided into three categories, perceived low family wealth (not very well off, not well off at all), perceived medium family wealth (average), and perceived high family wealth (very well off, quite well off).

Urban and rural

According to the sampling procedure, the information of selected schools in the survey can be retrieved, and the respondents were divided into urban and rural according to the school position.

School location
The respondents were categorized into three SES groups, good, fair and poor, according to their school's location in districts with different socioeconomic development (Beijing Municipal Bureau of Statistics 2010).

2.2.4 Statistical analyses

The analyses have been done to address the following aspects of the data according to the purpose of the study:

Item completion rate
Completion rate was computed for FASII items and total FAS scores as well as the other two SES indicators (parental educational level and perceived family wealth). Chi-square test was used to compare the completion rate of FAS items by gender and by age groups as well as the completion rate among different SES measures.

Reliability
The internal consistency of the FAS II items and item-rest coefficient were examined with the Cronbach's alpha coefficient. Spearman correlations were used to assess the association between individual FAS II item, the total FAS scores and FAS category. In order to examine whether the four FAS II items are to reflect a general underlying dimension of affluence, the fit of a one-factor solution was tested with confirmatory factor analysis (CFA) for categorical data using the Robust Weighted Least Square (WLSMV) estimator. The primary fit indices included the Comparative Fit Index (CFI) and the weighted root mean square residual (WRMR), as recommended in recent publications (Finney and DiStefano 2006). A CFI e 0.95 and WRMR < 1 indicates a good fit to the data.

Validity
Spearman correlations were used to assess the association between the total FAS scores with parental educational level and perceived family wealth. Two ordinal logistic regression models were used for analyzing the association between FAS category and other SES indicators. The unadjusted odds ratio (OR) from model 1 (univariate ordinal regression model) and the adjusted OR from model 2 (included all independent variables) were computed respectively. Construct validity was investigated with the Graphical Log Linear Rasch Model (GLLRM) with Differential Item Function (DIF) and Local Dependence (LD).

All data of the present study were entered by Epidata 3.1 with double entry and validation. The analyses of item completion rate, reliability and validity were done by Predictive Analytics Software (PASW, formerly SPSS), version 18.0 (SPSS, Inc., Chicago, IL, US). The CFA was analyzed by MPlus 6.1 (Muthén and Muthén 2010). The GLLRM was performed by DIGRAM 2.0 (Kreiner 2009). A *P*-value which was lower than 0.05 or 95% confidence intervals did not overlap was considered significantly different.

3 Results

3.1 Study I

Test-retest reliability

Table 2 reveals the values of ICC for all respondents by gender and age. Overall, the values of ICC of the FAS II items, FAS score and FAS category ranged from 0.76 to 0.95, with the lowest value for the item regarding family holidays, and the highest value for the item asking about own bedroom. According to Landis and Koch divisions of agreement (1977), all four items of FAS II as well as the FAS score and category showed at least substantial test-retest reliability. Gender and age differences of the agreement were only found for the item regarding own bedroom.

Table 2 ICC values for FAS II items, FAS score and FAS category by gender and age from Study I (N = 95)

	All (N = 95)		Boys (n = 51)		Girls (n = 44)		11 yrs (n = 44)		15 yrs (n = 51)	
	ICC	95% CI	ICC	95% CI	ICC	95% CI	ICC	95% CI	ICC	95% CI
Family car	0.88	0.83-0.92	0.85	0.75-0.91	0.92	0.86-0.96	0.81	0.68-0.89	0.92	0.86-0.95
Own bedroom	0.95	0.93-0.97	1.00	/	0.92*	0.86-0.96	0.79	0.65-0.88	1.00†	/
Family holidays	0.76	0.66-0.83	0.72	0.55-0.83	0.77	0.61-0.87	0.78	0.64-0.88	0.64	0.44-0.79
No. of computers	0.77	0.67-0.84	0.77	0.63-0.86	0.76	0.61-0.86	0.73	0.56-0.84	0.79	0.66-0.87
FAS score	0.88	0.83-0.92	0.85	0.75-0.91	0.92	0.84-0.96	0.83	0.70-0.90	0.88	0.80-0.93
FAS category	0.78	0.69-0.85	0.73	0.57-0.84	0.84	0.72-0.91	0.81	0.67-0.89	0.68	0.50-0.80

*Significant difference between gender groups

† Significant difference between age groups

3.2 Study II

3.2.1 Completion rate

In general, all items measuring SES in our study have a completion rate higher than 97%. Out of 5876 pupils, the first and second lowest completion rate were items for parental education (father 97.9% and mother 98.4%) and all the four items of FAS II have the same highest completion rate (99.7%) , which made the completion rate of the composite FAS scores 99.2%. However, no significant differences were found between the completion rates of the four FAS II items and two parental education items. We also examined the completion rates by gender and by age groups. There is no difference in the completion rates of those SES items by gender except for the question asking about the family holidays (p = 0.042) which showed that boys were slightly less likely to report their family holidays than girls. Significant differences of completion rates were found in the three age groups for the item about asking father's education ($p < 0.001$) and mother's education ($p < 0.001$), which indicated that younger children were less likely to report their parental educational level.

3.2.2 Internal reliability

As seen in Table 3, we examined the internal consistency of FAS II items and found a moderate association (± = 0.58). The alpha coefficient changed if single item was deleted from the scale. The item-rest coefficients suggested that deleting either family car (± = 0.47), or family holidays (± = 0.49), or numbers of computer (0.43) items resulted in a drop of internal consistency. On the contrary, if own bedroom was deleted from the FAS II items, the alpha coefficient would improve to 0.60. Higher internal consistencies were observed in older respondents.

Table 3 Cronbach Alpha coefficient for FAS II items by gender and age from Study II (N = 5876)

	Cronbach Alpha					
	Total	Boys	Girls	11yrs	13yrs	15yrs
All four items	0.58	0.59	0.57	0.56	0.56	0.62
Delete family car	0.47	0.49	0.45	0.48	0.46	0.49
Delete own bedroom	0.60	0.61	0.59	0.55	0.57	0.66
Delete family holiday	0.49	0.50	0.48	0.49	0.45	0.53
Delete No. Of computers	0.43	0.43	0.42	0.40	0.42	0.47

The results of the inter-correlations between the FAS II items and the composite FAS score showed moderate associations (more than 0.60) except for the item asking about own bedroom (0.34) (Table 4). Rather poor correlations were found within the FAS II items (from 0.16 to 0.39) and the poorest one was found between items asking about own bedroom and family car (0.16), but all items were intercorrelated.

Table 4 Spearman correlations of FAS II items from Study II (N = 5876)

	Family car	Own bedroom	Family holidays	No. Of computers
Own bedroom	0.16**			
Family vacations	0.32**	0.22**		
No. of computers	0.39**	0.20**	0.36**	
FAS score	0.67**	0.34**	0.69**	0.69**

** Correlation is significant at the 0.01 level (2-tailed).

The CFA analyzed by MPlus showed that the one-factor model fitted the data relatively well as indicated by the comparative fit index (CFI) of 0.99 and the weighted root mean square residual of 1.10. The standardised factor loading ranged between 0.49 (number of own bedroom) and 0.69 (number of computers).

3.2.3 Validity

The external validity of FAS II was evaluated by examining associations between FAS II and other SES indicators, using Spearman rank correlation (r_s), univariate and multivariate ordinal logistic regression analyses. Moderate associations were found between the composite FAS II scores with father's education ($r_s = 0.49$, $p < 0.001$), mother's education ($r_s = 0.48$, $p < 0.001$), and perceived family wealth ($r_s = 0.51$, $p < 0.001$).

Table 5 The distribution of variables by FAS category and ordinal regression results, FAS low as the referent (N = 5876)

	Total	FAS (low)		FAS (middle)		FAS (high)		Univariate OLR		Multivariate OLR	
	n	n	%	n	%	n	%	OR	95% CI	OR	95% CI
Overall	5876	2421	41.2	2178	37.1	1229	20.9				
Gender											
Boy	2816	1116	39.6	1015	36.0	655	23.3	0.84***	0.77-0.93	0.82**	0.79-0.88
Girl	3060	1305	42.6	1163	38.0	574	18.8	1.00		1.00	
Age											
11	1941	624	32.2	776	40.0	525	27.0	0.48***	0.43-0.54	0.54***	0.48-0.62
13	1930	779	40.4	753	39.0	373	19.3	0.70***	0.63-0.79	0.67***	0.59-0.77
15	2005	1018	50.8	649	32.4	331	16.5	1.00		1.00	
Area											
Urban	2833	833	29.4	1136	40.1	843	29.8	0.37***	0.33-0.40	0.75***	0.64-0.84
Rural	3043	1588	52.2	1042	34.2	386	12.7	1.00		1.00	
School location											
Level 1	1943	626	32.2	750	38.6	555	28.6	0.39***	0.35-0.44	0.57***	0.49-0.66
Level 2	1956	731	37.4	798	40.8	409	20.9	0.53***	0.47-0.60	0.62***	0.54-0.72
Level 3	1977	1064	53.8	630	31.9	265	13.4	1.00		1.00	
Father's education											
Low	2017	1329	65.9	539	26.7	130	6.4	11.87***	10.29-13.71	3.05***	2.46-3.78
Middle	2278	845	37.1	968	42.5	446	19.6	3.48***	3.06-3.96	1.66***	1.40-1.95
High	1456	187	12.8	624	42.9	637	43.8	1.00		1.00	

**overall effect of the variable in the model $p < 0.01$,
***overall effect of the variable in the model $p < 0.001$

Table 5 continued

	Total	FAS (low)		FAS (middle)		FAS (high)		Univariate OLR		Multivariate OLR	
	n	n	%	n	%	n	%	OR	95% CI	OR	95% CI
Mother's education											
Low	2154	1384	64.3	600	27.9	146	6.8	11.31***	9.80-13.07	2.54***	2.05-3.15
Middle	2301	818	35.5	999	43.4	470	20.4	3.34***	2.93-3.81	1.55***	1.31-1.83
High	1327	177	13.3	545	41.1	597	45.0	1.00		1.00	
Perceive family wealth											
Low	752	605	80.5	113	15.0	27	3.6	21.43***	17.44-26.34	10.51***	8.44-13.12
Middle	2918	1444	49.5	1126	38.6	325	11.1	5.02***	4.49-5.62	3.25***	2.88-3.67
High	2185	369	16.9	930	42.6	870	39.8	1.00		1.00	

***overall effect of the variable in the model $p < 0.001$

Table 5 shows the distribution of all variables used in this study by FAS category and the unadjusted and adjusted odds ratios (OR's) for all independent variables, with FAS low as the referent group. Students in rural areas were more likely to be located in the low FAS group. The percentage of respondents in high FAS group increased if they reported their father or mother has a higher educational background. Similarly, the percentage of students in high FAS group decreased with their perceived family wealth. Both models revealed the same significant association between FAS II category and all independent variables (Table 5). OR's for gender and age showed that girls and elder students were more likely to report less family affluence, compared to boys and young students. Similar findings were also established for students who lived in rural areas or studied in a school from the district with poor economic status. The multivariate analyses indicated that students whose fathers' educational level was low and middle were respectively around 3 times and 1.7 times more likely to report less affluence than students whose fathers' educational level were high. Similar results were also observed for respondents with low and middle level educational mothers, where the OR's were about 2 and 1.6 respectively. The most prominent finding was that students whose perceived family wealth was low were 10 times more likely to report their family affluence was also low, compared to those who perceived their family wealth as high.

To highlight the construct validity of the indicators, the GLLRM model fitting item responses for our data is shown in Figure 1. Two coefficients were significant revealing LD (Local Dependence) between items; number of cars-number of computers (^{3p} = 0.15) and number of cars-number of holidays (^{3p} = -0.13), which meant that there were correlation between the number of cars and number of computers, as well as the number of cars and number of holidays. However, these correlations are weak. The DIF (Differential Item Functioning) was observed between age and three items, 'own bedroom', 'number of holidays', and 'number of computers'. The results indicate that the chances of having own bedroom (^{3p} = 0.41) and number of computers (^{3p} = 0.16) increased with age, whereas the number of holidays (^{3p} = -0.28) decreased with age. The DIF was not found between gender and FAS II items.

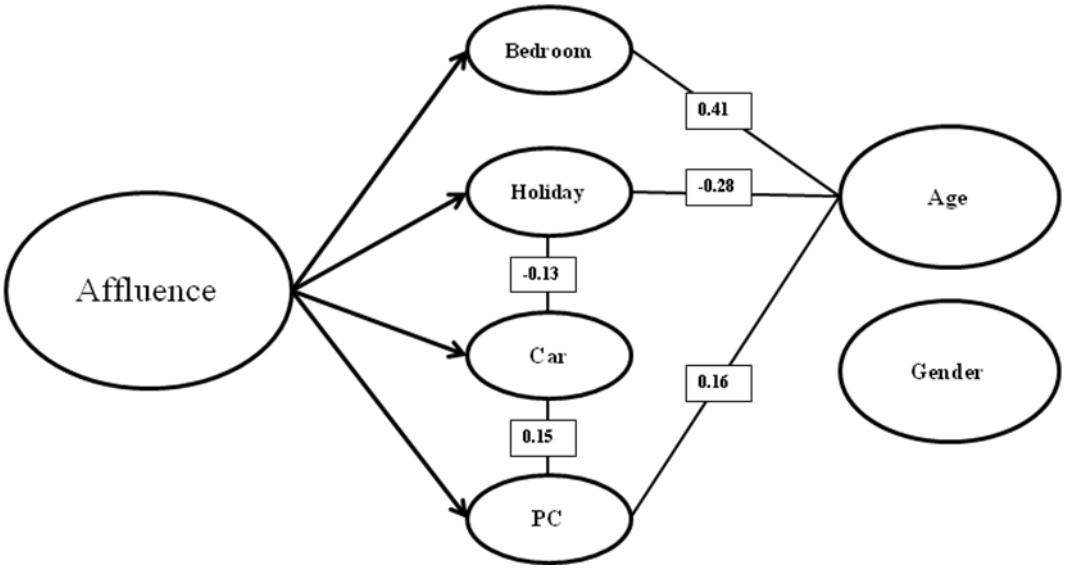

Figure 1 The generalization of FAS II to GLLRM (number in boxes are partial gamma coefficients, ^{3p}, indicate a significant correlation beyond the latent trait) from Study II (N = 5876).

4 Discussion and conclusion

To obtain the accurate finding of social inequalities in health, it is critical to employ reliable and valid indicators which measure socioeconomic status. Although FAS II, widely used in HBSC network countries in Europe and North America, was proved to be an easily answered and a useful indicator of child material affluence, it should be examined whether FAS II is applicable before it is used in countries other than the current HBSC countries. As the first study to assess the usability of FAS II in a Chinese context, in general, we found that of the FAS II items have high completion rates, a moderate internal reliability, at least substantial test-retest reliability, moderate associations with other SES indicators, only few LD and weak DIF. This indicates that the FAS II is a useful and valid SES measure for adolescents in the Beijing area.

Previous studies demonstrated the difficulties of obtaining information on parental education, occupation, and income, which are usually used as SES markers in adolescent studies and it has been reported in many studies that there is a high non-response rate for those questions (Cho and Khang 2010; Currie et al. 1997; Lin 2011; Molcho et al. 2007; Wardle et al. 2002). In contrast, it has been highlighted in previous studies that the FAS II items have much higher completion rates than other traditional SES indicators (Cho and Khang 2010; Lin 2011; Molcho et al. 2007; Wardle et al. 2002). In our study, therefore, it is not surprising that a higher proportion of the respondents answered the four FAS II items (99.7%) than items on parents' highest educational level (97.9% for father and 98.4% for mother). However, the completion rates for parental education questions in our study were much higher than previous studies, although they revealed the lowest completion rates among all SES indicators analyzed in the present study. One possible reason might be that students were instructed to answer all the questions in sequence at the beginning of the survey which generated very low non-response rate for all survey questions. Consequently, no significant difference was found between the completion rates of the four FAS II items and the other SES indicators. When comparing the completion rates of the SES measures across gender and age, we found that there was no gender difference, which is similar to the results reported by Molcho and his colleagues (2007) except for the question asking about the family holidays ($p = 0.042$). Age differences were found for items asking about parental education ($p < 0.001$), indicating that younger children were less likely to report their parental educational level, again, similar results were also found by Molcho et al (2007) and Lin (2011). We also found age differences of two FAS II items, family car ($p = 0.009$) and own bedroom ($p = 0.001$), which are not consistent with other studies (Lin 2011; Molcho et al. 2007).

Concerning the reliability of FAS II, in our study, the internal correlations between the FAS II items were low but all items were intercorrelated ($r_s = 0.16$-0.39, $p < 0.001$) and the Cronbach's alpha was moderate (0.58), which is in line with previous studies (Cho and Khang 2010; Lin 2011; Molcho et al. 2007; Schnohr et al. 2008). These results were understandable due to the limited range of the alternatives and each item describing a different aspect of family affluence (Wardle et al. 2002). Similar to earlier studies (Boudreau and Poulin 2009; Cho and Khang 2010; Lin 2011), we found that the item on own bedroom had weaker correlations with the other FAS II items and the composite FAS score. In addition, the item-rest coefficients in our study concluded that if the item on own bedroom

was deleted from the FAS scale, the alpha coefficient would improve whereas deleting any other of the three items would reduce the internal consistency. Those findings suggested that further examination should be considered to choose the most sensitive items in specific settings since country and culture difference may affect the relative contribution of the four FAS II items to the composite FAS II (Schnohr et al. 2008). One extra item which may be considered and tested in the future is that to ask the amount of weekly pocket money received by the student, which the child will reliably know the answer to, and is related to family affluence to some extent.

The significant association between FAS II and other traditional SES measures, such as parental education and/or parental occupation (Lin 2011; Molcho et al. 2007; Richter et al. 2009) were found in previous studies, although the strength of associations varied in different countries. The rather low strength of association found in the present study was accounted for by the fact that FAS and parental education and occupation examine different aspects of socioeconomic status per se, and therefore may not overlap (Molcho et al. 2007; Wardle et al. 2002). Our study revealed moderate associations between FAS and other SES indicators. The strength of associations in the present study (r_s = 0.48-0.51, $p < 0.001$) were higher than previous findings possibly indicating that the FAS II was related to other SES measures more closely in a Chinese context than others. We also assessed the external validity of FAS II by ordinal logistic regression and the results were in line with the correlation analyses which confirmed the significant association between FAS II and other SES indicators. For instance, the students who perceived their family wealth as low were 10 times more likely to be in the low FAS category than those who perceived their family wealth as high, suggesting that the FAS II was more likely measuring the similar dimension of SES as perceived family wealth. This finding presented the possibility of adding the item on perceived family wealth as one item of the FAS scale for the development of the family affluences measure in the future, in line with Schnohr and her colleagues' (2008), who have purposed that the FAS II can be used as a measure of wealth within a country and between countries, plus the item on perceived family wealth was included. However, we should notice that perceived family wealth is a subjective concept, and therefore it may not be comparable to measures of the FAS II which are more concrete in nature. Furthermore, the results of GLLRM model presented in this study indicated that the FAS II items are nearly locally independent and have very weak DIF, which can be considered as satisfied construct validity according to Rosenbaum (1989).

The strength of the present study is that we examined the test-retest reliability of FAS II, which has not been done and reported in earlier studies. As expected by Currie and her colleagues (2008), the results revealed that all four FAS II items and the composite FAS score and category had at least substantial test-retest reliability due to the objectivity of the measures. Moreover, it is the first study to examine the cross cultural application of the FAS II comprehensively using a large sample of Chinese adolescents. At the same time, the current study still has several limitations. First of all, the data were only sampled from the Beijing area due to the aims of the survey and the limited resources. As a country with huge socioeconomic difference such as China, it may raise the bias to determine the usability of the FAS II if the sample cannot represent the whole nation. Another major limitation is that the data were retrieved from self-report questionnaires from the adolescents and there is a lack of objective measures of respondents' family wealth, for instance, investigating the financial circumstances of the

parents. In order to examine and develop the FAS II as a SES measure in China, more research with other objective measures should be encouraged in more and wilder locations.

In conclusion, as the first study on the reliability and validity of the HBSC FAS II in an adolescent population in Beijing, the present study showed that the FAS II had a high completion rate, better than other SES indicators. Moderate internal reliability and at least substantial test-retest reliability, as well as adequate external and construct validity, were found for the FAS II. In conclusion, the FAS II is a useful and valid SES measure for adolescents in the Beijing area.

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