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ORIGINAL ARTICLE

Reliability and Validity of the Malay-Version Chicago Lead Knowledge Test (CLKT) among Parents of Preschool Children in Malaysia

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ABSTRAK

Objektif utama kajian ini adalah untuk mengesahkan ujian pengetahuan plumbum Chicago (CLKT) versi Bahasa Melayu. CLKT dipilih berdasarkan tinjauan literatur yang menyeluruh diikuti dengan terjemahan yang sistematik. Pengumpulan data melibatkan tiga fasa; ujian awal dilakukan di kalangan 70 ibu bapa, ujian semula dilakukan pada jarak dua minggu di antara responden yang serupa dengan kadar tindak balas 71.4% (n=50), dan satu ujian lain di kalangan 60 kumpulan profesional. Pengkaji melakukan ujian bukan parametrik kerana data taburan adalah tidak normal. Hasil ujian bukan parametrik tidak menunjukkan perbezaan skor pengetahuan purata yang signifikan dalam semua parameter demografi. Faktor kesukaran adalah antara 0.01 hingga 0.99. Purata ± sisihan piawai untuk faktor kesukaran adalah 0.52 ± 0.32. Separuh daripada 24 item (n=12) mempunyai faktor kesukaran kurang dari 0.75. Hanya satu item (item 6) yang mempunyai korelasi item-total kurang dari 0.2 (0.140). Pekali α Cronbach keseluruhan adalah 0.851. Tidak ada perbezaan yang signifikan yang dikesan oleh ujian Wilcoxon Signed-Rank antara skor keseluruhan dan skor ujian dan ujian semula untuk semua domain. Semua domain menunjukkan korelasi sederhana hingga kuat (Kolerasi Spearman: r=0.546 - 0.814, p<0.001). Ujian Mann-Whitney U menunjukkan skor pengetahuan yang jauh lebih tinggi dalam kumpulan profesional berbanding kumpulan ibu bapa untuk semua domain dan jumlah skor pengetahuan (p<0.001). CLKT versi Bahasa Melayu agak sukar tetapi mempunyai kebolehpercayaan dan validasi yang baik, oleh itu, instrumen ini dapat diterapkan ke dalam kajian berskala besar di masa akan datang.

Kata kunci: Bahasa Melayu, ibu bapa, kebolehpercayaan, plumbum, pengetahuan, validasi

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ABSTRACT

The primary objective of this study was to validate the Malay-version Chicago lead knowledge test (CLKT). The CLKT was chosen based on thorough literature review followed by a systematic translation. Data collection involved three phases; initial test was done among 70 parents, retest was done at two weeks apart among similar respondents with response rate of 71.4% (n=50), and another test among 60 professional group. The authors performed non-parametric tests since the data was not normally distributed. The non-parametric test results showed no significant mean knowledge score differences in all demographic parameters. The difficulty factor ranged from 0.01 to 0.99. The mean ± SD for difficulty factor was 0.52 ± 0.32. Half of the 24 items (n=12) had a difficulty factor of less than 0.75. Only one item (item 6) had item-total correlation of less than 0.2 (0.140). The overall Cronbach's α coefficient was 0.851. No significant difference was detected by the Wilcoxon Signed-Rank Test between the overall score, the test and retest scores for all domains. All domains showed moderate to strong correlation (Spearman's Correlation: r=0.546 - 0.814, p<0.001). The Mann-Whitney U test showed a significantly higher knowledge score in professional group compared to parent group for all domains and total knowledge score (p<0.001). The Malay-version CLKT was moderately difficult but had a good reliability and validity. Thus, this instrument can be applied in future larger-scale study.

Keywords: Malay, lead, knowledge, parent, reliability, validity

INTRODUCTION

Lead, a non-ferrous metal, is a common component in many industries and consumer products. Lead exposure among children is not uncommon. Even at minute levels, lead could adversely impact children's health. The central nervous system of children who have been subjected to lead exposure are highly likely to experience irreversible damages, including abnormal cognitive development and neurobehavioral disorders (Baranowska-Bosiacka et al. 2012; Baranowska-Bosiacka et al. 2013; Jakubowski 2011). A blood lead level (BLL) of less than 10 µg/dL was found to affect intellectual ability of children (Jusko et al. 2008).

Children are included in the sensitive group as they have unique physiological characteristics. They have higher rate of absorption in the digestive system compared to adult (Hauptman et al. 2017), and may be boosted further due to fasting and lack of iron, zinc or calcium (Ab Latif et al. 2015; Li et al. 2016). The BLL of children who live in the contaminated environments such as nearby main road, construction site, factory, quarry etc. typically rise quickly between the ages of 6 and 12 months and peaking between the ages of 18 and 36 months

(Lowry et al. 2016). During the peak age, they have the habit of mouthing and pica; eating substances other than food due to inability to differentiate the object or food that they put into their mouth.

About more than 30% of raised BLL in children were caused by exposure to lead sources other than paint; pencils, colour pencils, crayon, toys, electronic devices, batteries, ceramics, food, jewellery, petrol, traditional remedies and even human breast milk (Hon et al. 2017). As cigarettes contain heavy metals including lead, children exposure to cigarette smoke also causes increased blood lead level (Li et al. 2016). Workmen who are involved in the lead-related industrial fields such as painting, renovations, demolitions, scrap metal works, piping, etc could contribute to take-home contamination by carrying home lead dust from their workplace on their clothes, footwear, skin, and other personal effects (Hauptman et al. 2017; Newman et al. 2015).

Parents as a guardians of their children should have an adequate knowledge about lead hazard to ensure that their children are at the lowest possible risk of lead poisoning. Parents with high educational levels and socioeconomic status provided a good environment for their children (Panahandeh et al. 2017). The knowledge exploration about lead hazard and its prevention strategies in Malaysia remains low and the prevalence of parent's knowledge is unknown. Early intervention program can only be implemented effectively if the knowledge base among parents is available. Intervention strategies such as health promotion through various methods; individual consultation, mass media advertisement, group discussion etc., may further enhance parents' attitude and behaviour. An interventional study's finding showed that the educational treatment increased parents' knowledge on lead hazard and prevention strategies, and improved children BLL (Wasserman 2012). A prospective clinical trial done in the U.S. showed that the video tape of lead knowledge significantly increased the knowledge scores among parents and reduced the children's risk of lead poisoning (Kersten et al. 2004).

A 24-item Chicago Lead Knowledge Test (CLKT) is one of the popular instruments used globally to assess parental knowledge regarding lead exposure towards children and its prevention strategies. It was originally developed and validated by Mehta and Binns among parents of children aged 6 years old or younger who presented for child health care at primary care practices in Chicago urban areas in 1998 with the primary aim to assess the parents' knowledge about lead and its prevention strategies (Mehta & Binns 1998), and has been used by other researchers with similar objectives (Adebamowoet al. 2006; Huang et al. 2017). It has a very good agreement between test-retest response to individual items (88-100%) and strong correlation (0.96) (Mehta & Binns 1998). The CLKT consisted of four main domains; general knowledge (item 1-5), exposure (item 6-16), prevention (item 17-20) and nutrition (item 21-24) with a minimum score

of zero and a maximum score of 24 marks. For individual respondent, a correct response for each item was allocated a score of one mark, while incorrect and 'don't know' answers were zero.

Different studies demonstrate different validation strategies to determine adequacy of what the CLKT measures and how well it can measure the knowledge. For example, a study done in U.S. evaluated the applicability of the CLKT to a targeted (high-risk minority) population using factor analysis strategies (Rabito et al. 2004). However, the CLKT has neither been validated in the Malay-version nor been used among multi-racial adult population in Malaysia. Therefore, the primary aim of this study was to validate the Malay-version CLKT using discriminant validity strategy among parents of preschool children to be used in the future larger-scale study.

MATERIALS AND METHODS

A translation work was done in the beginning of the study based on the International Society for Pharmacoeconomics and Outcome Research (ISPOR) which involved 10 steps; i) preparation, ii) forward translation, iii) reconciliation, iv) backward translation, v) backward translation review, vi) harmonisation, vii) cognitive debriefing, viii) review of cognitive debriefing and finalisation, ix) proof reading, and x) final report (Wild et al. 2005). Initially, the CLKT was identified based on thorough literature review and was chosen to be assessed in this study. In view of copyright, the authors emailed the original developer of the questionnaire for permission to translate and use. The concept and knowledge about the items used in the questionnaire were gained from articles reading and experts' opinion. The decision to modify the items were based on the agreement between the experts.

The forward translation from English language into the Malay language, and backward translation were done by two different pairs of experts who fulfil the criteria to be a translator; i) able to speak and write fluently in both languages, ii) expert in related field (environmental health and toxicology), and iii) had minimum requirement for language test. The review of the translation was discussed to find agreement for the suitable words and sentence of the translated item. Harmonisation was conducted to compare the newly translated item (Malay) with the original language of the instrument (English). To evaluate the face validity (suitability of the words and sentence used for each item), cognitive debriefing and review of cognitive debriefing were performed among the laymen who work in the Department of Community Development, also known as Kemajuan Masyarakat (KEMAS). The final version of the instrument was proofread by independent certified proof-reader and the Malay-version CLKT was ready to be printed.

After completion of the translation process of the instrument, a primary questionnaire validation study was proceeded with the main purpose of assessing the validity and reliability of the Malay-version CLKT. This study

was conducted in Federal Territory of Kuala Lumpur from October 2019 until December 2019. There were three phases of data collection with different purposes and activities. In the first phase of data collection, the parents of preschool children aged 3 to 6 years old from the government (KEMAS) kindergarten classes in Cheras, Kuala Lumpur were identified. A total of 70 parents from 7 kindergarten classes were purposively selected and recruited into this study. Informed consent and baseline information, including demographic data and environmental background were collected from the parents. The questionnaire was administered whilst the parents sent their children to the kindergarten. After instructions were given by the researcher, the parents completed the questionnaire themselves in average time of 15 minutes. To ensure that all questions were answered, the researcher checked the completed questionnaire. After two weeks, in the second phase of data collection, a similar Malay-version CLKT was given to the same group of parents when they were sending their children to the kindergarten.

The third phase of data collection was conducted to acquire a more impartial evaluation of the validity of the Malay-version CLKT. A total of 60 doctors from the nearest university hospital were recruited into the study. They were doctors who further specialized in Public Health Medicine in the Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia (UKM) Medical Centre. The informed consent and baseline information including demographic data were collected from the doctors. The same questionnaire which were answered by the parents was administered once to the doctors in the hospital and were completed in 15 minutes. To ensure that all questions were answered, the researcher checked the completed questionnaire. The ethical approval was obtained from UKM Research and Ethics Committee and National Medical Research Register (NMRR), Ministry of Health (MOH) Malaysia

All data were entered and analysed using the Statistical Package for Social Sciences (SPSS) version 22. Data normality was assessed using two main methods: graphical (visual inspection) and numerical (statistical test). The normality was explored graphically based on histogram and Q-Q Plot, and statistically based on skewness, kurtosis and Shapiro-Wilks statistic. Frequency and percentage were calculated for each of parents' demographic parameters. Mean $\pm$ SD of total knowledge score was compared between different patients' demographic parameters. The level of knowledge of different sub-categories of demographic parameters was reflected by the score. The non-normal distribution of data required use of non-parametric tests. The mean comparison between two groups was calculated using Mann-Whitney U Test, and mean comparison between more than two groups using Kruskal-Wallis Test.

The difficulty factor was calculated to determine the difficulty of a question by defining the proportion of parents

who selected the correct response to that question and calculating the sum of correct responses divided by the sum of responses. The high difficulty factor reflects the easiness of the question. A value higher than 0.75 means that the question is too easy and therefore, inadequate. Most effective questions are within 0.3 and 0.7 difficulty values, with 0.5 being the optimum. A Cronbach's coefficient was calculated to evaluate the internal consistency of the Malay-version CLKT. A value of more than 0.70 shows good internal consistency. Increasing the homogeneity of the scale was possible by deleting an item that significantly inflates the coefficient. Wilcoxon Signed-Rank Test was performed to observe any significant mean knowledge score difference between the test and retest results for each item and for each domain. Spearman's Correlation Test was used to determine the strength of correlation for knowledge score between test and retest of each domain. Mann-Whitney U Test was performed to observe any significant mean knowledge score difference between the parent and professional group in every domain and total knowledge.

RESULTS

During modification of the instrument, one item (Statement: "Apartment owners are required to tell renters about known lead-containing paint in the apartment when a lease is signed") was deleted since the statement was not applicable in Malaysia. One item (Statement: "Some pottery imported from Mexico or other countries is not safe to use in cooking or for eating because it contains lead") was modified into a new phrase (Statement: "Some toys imported from China or other countries is not safe to use because it contains lead"); and one item (Statement: "Some stationeries such as crayon and colour pencil imported from China or other countries is not safe to use because it contains lead") was added into the instrument.

Statistically, the data of knowledge score were found to be not normally distributed. Skewness and kurtosis values for knowledge score were beyond acceptable range of -1.00 and +1.00, while the Shapiro-Wilks Statistics p-value for knowledge score was less than 0.05, indicating that the data was not normally distributed. From Table 1, a total of 70 parents of children who were 3 to 6 years old participated in this study. Mothers 78.6% (n=55) and parents between 30 and 40 years old 77.0% (n=49) made up most of the respondents. The mean $\pm$ SD, median and interquartile range (IQR) age of the parents were 34.63 $\pm$ 4.86 years old, 33.00 years old and 6.00 years old, respectively. Most respondents were Malay 82.9% (n=58). About 58.6% (n=12) of the parents had a secondary education. About 64.3% (n=45) of the parents had income less than RM4000.00. The mean $\pm$ SD, median and IQR monthly household income were RM3859.29 $\pm$ 2342.26, RM3000.00 and RM1825.00, respectively. The vast majority of the parents stayed in flat house (65.7%) (n=46), stayed in house built more than 42 years (71.4%) (n=71.4%), lived

Table 1: Knowledge score and its association with respondents' demographic characteristics

Parameter	Descriptive Analysis	Comparison of Mean Knowledge Score[a]		
	Frequency (%)	Mean ± SD	Mean Rank	p-value
Gender				
Male	15 (21.4)	11.80 ± 4.51	33.57	0.676
Female	55 (78.6)	12.75 ± 3.06	36.03	
Age				
≤30 years old	11 (15.7)	11.18 ± 3.76	25.41	0.169
31-40 years old	49 (70.0)	12.92 ± 3.26	38.04	
> 40 years old	10 (14.3)	12.20 ± 3.65	34.15	
Race				
Malay	58 (82.9)	12.43 ± 3.16	34.37	0.304
Non-Malay	12 (17.1)	13.08 ± 4.54	40.96	
Education Level				
Secondary Education	41 (58.6)	12.10 ± 3.39	32.83	0.189
Tertiary Education	29 (41.4)	13.17 ± 3.38	39.28	
Monthly Household Income				
< RM4000.00	45 (64.3)	12.71 ± 3.12	36.21	0.795
RM4000.00-RM8000.00	18 (25.7)	12.28 ± 3.63	32.83	
>RM8000.00	7 (10.0)	12.14 ± 4.91	37.79	
Type of House				
Terrace	16 (22.9)	11.88 ± 3.56	31.88	0.233
Condominium	8 (11.4)	10.63 ± 4.17	26.69	
Flat House	46 (65.7)	13.11 ± 3.11	38.29	
Year of House Built				
<1978	20 (28.6)	11.85 ± 3.39	29.13	0.095
≥1978	50 (71.4)	12.82 3.40	38.05	
House Near Main Road				
Yes	64 (91.4)	12.48 ± 3.35	35.46	0.958
No	6 (8.6)	13.17 ± 4.26	35.92	
House Near Factory				
Yes	3 (4.3)	13.67 ± 1.16	41.33	0.610
No	67 (95.7)	12.49 ± 3.47	35.24	
House Near Construction				
Yes	10 (14.3)	12.40 ± 4.25	33.70	0.761
No	60 (85.7)	12.57 ± 3.29	35.80	
Tap Water Consumption				
Yes	68 (97.1)	12.54 ± 3.45	35.65	0.710
No	2 (2.9)	12.50 ± 0.71	30.25	

Parameter	Descriptive Analysis	Comparison of Mean Knowledge Scorea		
	Frequency (%)	Mean ± SD	Mean Rank	p-value
Smoking Status				
Active Smoker	4 (5.7)	11.25 ± 4.43	30.25	0.419
Passive Smoker	2 (2.9)	15.00 ± 0.00	54.00	
Ex-Smoker	1 (1.4)	15.00	54.00	
Non-Smoker	63 (90.0)	12.51 ± 3.40	34.95	

[a]Comparison of mean knowledge score was calculated using Man-Whitney U Test for 2 groups comparison and Kruskal-Wallis Test for more than 2 groups comparison

near the main road (91.4%) (n=64), lived far from the factory (95.7%) (n=67), lived far from construction site (85.7%) (n=60), consumed tap water as a source of drinking water (97.1%) (n=68), and were non-smoker (90.0%) (n=63). From the same table, the non-parametric test results showed no significant mean knowledge score differences between sub-categories in all demographic parameters; gender, age, race, education level, monthly house income, type of house, years of house built, house near main road, house near factory, house near construction, tap water consumption and smoking status.

Table 2 displays the correct answer for each item. The difficulty factor measured the correct answer per total response for each item. The difficulty factor ranged from 0.01 to 0.99. The most difficult item was item 14 (difficult factor 0.01) and the item with the most correct answer was item 1 (difficulty factor 0.99). The mean ± SD for difficulty factor was 0.52 ± 0.32. The difficulty factor of half of the 24 items (n=12) was less than 0.75, indicating that the difficulty of CLKT was moderate. Between test and retest responses to individual item, the percentage of agreement was between 56.0 and 100.0%. There were 7 items with percentage of agreement at 90.0%, 15 items with percentage of agreement between 60.0 to 90.0% and 2 items with percentage of agreement less than 60.0%. Using the Wilcoxon Signed-Rank test, the test-retest reliability showed that only one out of 24 items (item 16) were significantly different ($p<0.05$).

Determining items not consistent with the other items required the use of a corrected item-total correlations. To be considered as acceptable, the item-total correlations had to exceed 0.2. Based on this criterion, only one item (item 6) did not meet this requirement (0.140). We also calculated the Cronbach's coefficient value for each item that showed the effect of deleting that item from the computation of the overall Cronbach's coefficient α value. After removing any of these 24 items, the internal consistency of the Malay-version CLKT was similar to the overall Cronbach's α coefficient of 0.851 (Cronbach's α if item deleted ranging from 0.838-0.852). Therefore, all 24 items were retained. The internal consistency for 24 items was more than 0.75 which indicate good reliability of

Table 2: The psychometric properties of the modified Malay-version CLKT

Domain	Item Number	Correct answer	Difficulty factor	Agreement between test-retest (%)	Reliability test[a] (p-value)	Corrected item-total correlation	Cronbach's α if item deleted	Overall Cronbach's α
General knowledge	1	True	0.99	100.00	1.000	0.291	0.851	
	2	True	0.89	96.00	1.000	0.353	0.848	
	3	False	0.11	74.00	0.396	0.405	0.846	
	4	False	0.19	68.00	0.811	0.441	0.845	
	5	False	0.10	56.00	0.602	0.391	0.847	
Exposure	6	True	0.93	98.00	0.317	0.140	0.852	
	7	True	0.91	92.00	0.059	0.508	0.845	
	8	True	0.93	90.00	0.066	0.432	0.846	
	9	True	0.66	86.00	0.860	0.371	0.848	
	10	True	0.69	82.00	0.855	0.483	0.843	0.851
	11	True	0.81	96.00	0.157	0.348	0.848	
	12	True	0.70	78.00	0.636	0.482	0.843	
	13	False	0.43	64.00	0.599	0.441	0.845	
	14	False	0.01	78.00	0.329	0.334	0.848	
	15	False	0.20	68.00	0.150	0.610	0.838	
	16	True	0.19	72.00	**0.045***	0.463	0.844	
Prevention	17	True	0.91	92.00	0.458	0.309	0.849	
	18	False	0.26	58.00	0.331	0.474	0.843	
	19	False	0.14	68.00	0.594	0.236	0.853	
	20	True	0.59	78.00	0.715	0.304	0.850	
Nutrition	21	False	0.33	72.00	0.922	0.415	0.846	
	22	True	0.43	72.00	0.174	0.525	0.841	
	23	True	0.57	72.00	0.358	0.523	0.841	
	24	True	0.59	64.00	0.751	0.529	0.841	

[a]Reliability test for each item was measured using Wilcoxon Sign-Rank Test
*Statistically significant at p-value < 0.05

the Malay-version CLKT.

From Table 3, the mean ± SD score in the retest were higher than the initial test for all domains except prevention. However, for all domains, the Wilcoxon Signed-Rank Test observed no significant difference in each domain between the test and retest scores ($p>0.05$), indicating that each domain score was consistent. All domains had moderate to strong correlation ($r=0.546$ - 0.814, $p<0.001$) in Spearman's Correlation, indicating that the Malay-version CLKT had a stable reliability. Higher mean scores for all domains were observed in the professional group than the parent group, affecting the mean ± SD of total

Table 3: Knowledge scores of the professional and patient group at test and retest by domain

	Test		Retest		Reliability Test [A] versus [B]			Test		Discriminant Validity [A] versus [E]	
	Patients (n =70) [A]		Patients (n = 50) [B][a]		Wilcoxon Signed Rank Test [C]		Spearman's Correlation [D]	Professionals (n = 60) [E]		Mann Whitney U	
Domain	Mean ± SD	Median	Mean ± SD	Median	Mean/rank	z-value	Correlation Coefficient	Mean ± SD	Median	Test [F]	z-value
General knowledge	2.27 ± 0.82	2.00	2.44 ± 0.84	2.00	8.60/8.45	-1.380#	0.546*	3.32 ± 0.89	3.00	47.43/86.58	-6.264*
Exposure	6.46 ± 1.86	7.00	6.74 ± 1.61	7.00	13.23/13.70	-0.781#	0.697*	9.20 ± 1.44	10.00	42.76/92.03	-7.522*
Prevention	1.90 ± 0.85	2.00	1.88 ± 0.92	2.00	9.50/10.56	0.000#	0.675*	3.18 ± 0.97	3.50	46.09/88.14	-6.583*
Nutrition	1.91 ± 1.35	2.00	2.08 ± 1.32	2.00	11.75/12.19	-0.639#	0.623*	2.87 ± 1.10	3.00	53.50/79.50	-4.062*
Total Knowledge Score	12.54 ± 3.40	13.00	12.98 ± 3.30	13.00	19.29/18.83	-1.250#	0.814*	18.55 ± 2.63	18.00	39.59/95.73	-8.497*

[a]20 patients were excluded from the test-retest as they did not come during retest
*Statistically significant at p-value < 0.001
#Statistically not significant at p-value > 0.05

knowledge score (12.54 ± 3.40 versus 18.63 ± 2.63). The Mann-Whitney U test used for discriminant validity showed that the score between parents and professional group was significantly different for all domains and total knowledge score ($p<0.001$). Professional group showed higher knowledge score in the Malay-version CLKT compared to parents' group. This indicates that the Malay-version CLKT is significantly valid.

The Malay-version CLKT from current study was compared to similar validated instruments to assess the parents' knowledge on lead exposure towards children (Table 4). Both psychometric properties of the Malay-version CLKT and the original CLKT were similar in terms of mean age of respondents, type of respondents, number of items, number of domains, duration of test-retest, correlation and mean ± SD score. The psychometric properties of the Malay-version CLKT were quite different from the Chinese-version CLKT in term of mean age of respondents, number of subjects, type of subjects, number of items, number of domains, duration of test-retest and mean ± SD score. The Cronbach's coefficient and difficulty factor were not documented by the authors who validated the original CLKT and the Chinese-version CLKT. There was a wide range of percentage agreement

Table 4: Comparison of psychometric properties of the modified Malay-version CLKT with other versions of CLKT

Tools	Modified Malay-version CLKT[a]	English-version CLKT[b] (Mehta & Binns 1998)	Modified Chinese-version CLKT (Huang et al. 2017)
Year of study	2019	1998	2017
Mean age ± SD (years)	34.63 ± 4.86	32.90 ± 5.90	51.2[#]
No. of subjects	70	2225	287
Type of subjects	Parents of children 3 to 6 years old	Parents of a child 0 to 6 years old	Village doctors
No. of items	24	24	28
No. of domains	4	4	5
Cronbach's α	0.85	NR	NR
Mean difficulty factor ± SD	0.52 ± 0.32	NR	NR
Pearson Correlation Coefficient	0.85	0.96	0.96
Duration between test and retest	Within 2 weeks	Within 2 weeks	Within 5 days
Agreement between test and retest response to individual items (%)	56-100	88-100	90-100
Mean score ± SD (%)	12.54 ± 3.40	12.27 ± 3.70	9.8 ± 8.6

[a]Instrument from the current study
[b]Original instrument
NR = Not reported
[#]Standard deviation not reported

between test-retest responses to individual items in the Malay-version CLKT (56.0-100.0%) as compared to original CLKT (88.0-100.0%) and Chinese-version CLKT (90.0-100.0%).

DISCUSSION

This study was conducted to establish a valid and reliable questionnaire that spans all facets of parents' knowledge about lead exposure towards their children. This questionnaire is important in future studies to investigate the relationship between the lead levels of the children (through blood, urine, nail or hair sampling test) and Malaysian parents' knowledge. This is the first translated and validated questionnaire that measures parents' knowledge about lead exposure towards children in Malaysia.

The results for mean ± SD knowledge score difference in all different demographic parameters was found to be not significant, probably because of the relatively small sample size (n=70) and method of sampling (purposive). Since this was a primary questionnaire validation study, what matters the most was the reliability and validity of the instrument. This primary study, defined as a small-scale study, can serve many purposes, including examining the practicality and feasibility of the methods to be used in a subsequent larger and more comprehensive investigation. In general, while sample size calculations may not be required for some primary studies, the high representation of the target study population by the samples gathered for a pilot is imperative and based on the main study's same inclusion and exclusion criteria. A sample of 10 or even fewer is sufficient to assess clarity of instructions or item wording, acceptability of formatting, or ease of administration. The sample size should be bigger if the aims for a pilot are to determine the internal consistency and test-retest reliability or to assess the item performance (Hertzog 2008). As a rule, an expansive study is necessary to provide beneficial results about the aspects being assessed for feasibility (Thabane et al. 2010). A previous study has suggested that a preliminary survey or scale development requires a reasonable minimum of 30 representative participants from the population of interest. In the aforementioned study, increasing the sample size impacted the Pearson correlations, length of the confidence interval, and Cronbach's coefficient beginning from when the sample size was 30, no matter what number of the items (Johanson & Brooks 2010).

The difficulty of the Malay-version CLKT was moderately difficult as more than half of the total items (16 items) had the difficulty factor of less than 0.75 (item 3, 4, 5, 9, 10, 12, 13, 14, 15, 16, 18, 19, 21, 22, 23, and 24). The most difficult question was item 14 (Statement: "Most cases of childhood lead poisoning are caused by drinking water that contains lead") with difficulty factor of 0.01. Only one out of 70 respondents were able to answer the item correctly (the answer was 'false'). The answer for this item was "Although water with lead in it is one way to poison children, water is usually safe. Most cases of lead

poisoning are a result of lead paint dust or certain kind of domestic product containing lead such as color pencils, crayons, die-cast toys, cosmetic etc. being ingested by children" (Mehta & Binns 1998).

The mean score ± SD of the Malay-version CLKT was found to be higher than the mean score ± SD of the Chinese-version CLKT in previous study, even though the respondents from current study were layman persons as compared to the respondents who consisted of village doctors. It showed that the baseline knowledge of parents about the exposure of lead towards children was fair. The mean score ± SD of this instrument was similar to original CLKT, indicating that the difficulty of this instrument did not change much despite translation into different language.

The Cronbach's α coefficient and the test-retest results showed the excellent reliability of this questionnaire. As it surpassed the minimum Cronbach's coefficient α of 0.70, the internal consistency reliability of this questionnaire was good and acceptable. Only one item out of 24 items (item 16, statement: "Some herbal or traditional home remedies contain lead") in the test-retest reliability was significantly different in the Wilcoxon Sign-Rank Test, affecting the domain scores on exposure towards lead ($p<0.05$) and indicating that the answer given by the respondents for that item was not consistent between test and retest. The reason for inconsistent response for this item was the respondents had guessed either right or wrong answers during the initial test and failed to recall their previous answer in the second test, which is similar to what had happened in previous study (Lai et al. 2012). In the current study, about 20% of total parents (n=10) who answered true/false in the initial test, then answered different response option ('don't know') in the retest. Despite having significant inconsistency of the response answer for item 16, the authors decided to retain the item because the content is relevant to local culture practice of making and consuming traditional home remedies as alternative treatment.

Three major forms make up the widely accepted classification of validity i.e. content, criterion and construct. The amount of adequate coverage an instrument contributes to the topic under study defines content validity. Criterion validity, an external validity, shows the success of measures used for some empirical estimating purposes. Construct validity, assessed through convergent and discriminant validity, shows the extent that the results obtained from the use of the measure fits the theory around which the test is designed (Srinivasan & Lohith 2017). Correlation with scores from another instrument or outcome for which correlation would be expected, for example, to assess the knowledge level of the respondents, the score differences of each extreme group would support the validity (Cook & Beckman 2006).

Two out of three major forms of validity were conducted in this study. Content validity was performed during modification of the original

CLKT (step 1 of systematic translation) through extensive discussion among the experts (Public health physician, environmental toxicologist, and academic lecturer). Discriminant validity, which was chosen in validating the instrument to prove the outcome of the instrument (knowledge score), was consistent with the prediction made earlier about the knowledge ability of parent group versus professional group. The Malay-version CLKT was a scoring-based questionnaire and there was no indication to perform factor analysis since it only measured a single outcome (knowledge) and showed no effect towards total knowledge score despite rearrangement of the items into new suggested domain based on the factor loading. In other words, the total knowledge score measures the patients' knowledge levels instead of the individual domain.

Higher mean ± SD of total knowledge scores of the Malay-version CLKT was observed in the professional group than in the parent group whom majority of them received secondary education as their highest academic achievement (18.55 ± 2.63 versus 12.54 ± 3.40). The doctors with 73.3% of them (n = 44), who have had formal exposure about environmental health and toxicology, were expected to have higher level of knowledge as compared to layman parents. The significant results of Mann-Whitney U Test proved the obvious separation of two groups (doctors versus parents) for every domain and total knowledge score. This indicates that the Malay-version CLKT had a good construct validity. In other words, the valid instrument can be applied to discern the level of knowledge about lead exposure towards children among different group of respondents.

There are limitations in this study. First, the demographic background of the respondents was not normally distributed, which could be due to the method of purposive sampling. The unequal proportion of every demographic parameter such as race, make it difficult to interpret the statistical results. Ethnic differences may play a role in creating differences in the factor pattern as well as reproducibility of the questionnaire. It would be much more desirable to examine the validity and reliability of the questionnaire in a broader ethnic group comprising Chinese, Indian and others, as Malaysia is multiracial country. Secondly, there were loss to follow-up among parents during retest. Almost one third of total parents (n = 20) were unable to complete the repeated questionnaire due to reasons; refusal and different respondent who attended the second session while sending their children to the kindergarten (spouse or caretaker). Test-retest has its own problem, including loss to follow-up, which is almost inevitable in population-based studies. If follow-up is incomplete, there will be missing data at the end of the study which can affect the internal validity of the study. However, the issue of loss to follow-up can be improved through; i) effective communication when conveying the instruction and protocol, ii) availability and variety of method of contacting the parents such as phone number, email, and other form of social media, iii) token

of appreciation for the parents who completed the follow-up, iv) provision of assistance to the parents in term of questionnaire administration, and v) correct time and place to follow-up such as while sending children to the kindergarten and during parent-teacher gathering event or meeting.

CONCLUSION

This study performed a psychometric analysis that showed a moderately difficult, but reliable and valid instrument to measure Malaysian parents' knowledge about lead hazard and its prevention, and to identify the high risk group among children who are exposed to lead. Therefore, early BLL screening and further intervention can be implemented effectively for this group.

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