

# Psychometric evaluation of the Thai version of Early Childhood Oral Health Impact Scale (Th-ECOHIS): a cross sectional validation study

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## Research article

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# Abstract

**Background:** Early childhood caries (ECC) is prevalent in Thailand. There has never been an appropriate tool to measure its impact on children. This study translated Early childhood oral health impact scale (ECOHIS), a widely used proxy-reported questionnaire developed in the United States for measuring the oral health related quality of life of preschool children and their families and adopted into many countries, into Thai (Th-ECOHIS). Its psychometric properties were investigated in Thai caregivers and their children.

**Methods:** Cultural adaptation for the scale development within Thai context was processed using forward–backward translation by experts. A face and content validation test were conducted among a group of 20 caregivers to attain the final Th-ECOHIS. Psychometric testing was done on 3-year-old-child-caregiver pairs in Bangkok with the interviewer-administered mode. Children’s oral health was indicated by caries experience (decayed, missing and filled primary teeth, dmft) and treatment need. The caregivers answered the Th-ECOHIS and global questions regarding perception of their children’s oral health. Reliability was assessed by measuring internal consistency and reproducibility using Cronbach’s alpha coefficient. Test-retest reliability was managed at 2-week interval in 10% of samples using the intraclass correlation coefficient calculated by two-way analysis of variance. The discriminant validity was tested by the relationship between the severity of dental caries, treatment need and Th-ECOHIS scores using Kruskal-Wallis test.

**Results:** A total of 214 child-parent pairs participated. Twenty-two percent had ECC (dmft 1-3) and 17.3% had severe ECC (dmft 4 or higher) with mean (SD) dmft 1.63 (2.92). All items in the original ECOHIS were retained in the Thai version. The test-retest reliability of Th-ECOHIS was 0.87; internal consistency was 0.85; the total of Th-ECOHIS scores were significantly correlated with the global rating of oral health question ( $r = 0.604$ ). Th-ECOHIS scores in both child and family impact sections and total were significantly associated with the severity of caries ( $p < 0.001$ ) and treatment need ( $p < 0.001$ ).

**Conclusions:** Th-ECOHIS demonstrated good reliability and validity. It could be used to assess the impacts of ECC on quality of life of Thai pre-school children through caregiver and compare to other countries.

## Background

Early childhood caries (ECC) has been recognized by health care professionals as one of the major health problems in young children around the world. The severity of the problem is commonly described by clinical indicators such as the prevalence and number of decayed, missing, and filled teeth. The ECC prevalence ranges from 23% to 90% worldwide, and 70% of the countries studied had a prevalence of more than 50% in 5-year-old children [1].

An attempt to demonstrate the negative impacts of ECC have been made in various ways. Objective parameters, such as a child’s body weight and height, restricted growth, and future dentition problems,

have been shown as evidence of the impact [2-6]. However, these little influence on encouraging preventive practices in the groups affected by ECC or at risk for it. Subjective assessments related to pain, school performance, and restriction of family function have later been brought to attention to clearer demonstrate the impact of ECC [7, 8].

The quality of life for children commonly incorporates at least four dimensions: the physical, psychological, social, and functional dimensions [9]. They cannot be easily assessed by objective indicators. Instead, comprehensive multidimensional and subjective evaluations are needed to capture the effects of ECC on these dimensions. Subjective assessments in young children are difficult to make due to a child's level of cognitive function [10, 11], but they are also necessary. For a young child's quality of life, adults and caretakers are vital because they are able to perceive children's needs and are aware of problems in fulfilling the needs. They can also speak up for young children who may not be able to do so for themselves [7]. They may be indirectly affected by a child's oral health problems, as well [7].

The Early Childhood Oral Health Impact Scale (ECOHIS) was drawn up in the United States by Pahel and colleagues and published in 2007 [8]. It specifically measures the impact of ECC on a preschool child's quality of life. It was designed to assess a child's oral function, social function, and psychological performance, as well as the indirect effects of ECC on family distress and function. To overcome the limitations of a young child's ability to express thoughts and respond to questions, the ECOHIS focuses on perception of parents or main caregivers. It has been translated into several languages and cross-culturally adapted in many countries worldwide: France, China (Hong Kong), Turkey, Brazil, Venezuela, Lithuania, Iran, Malaysia, Saudi Arabia, Chile, Germany and Madagascar [12-24]. It has a high degree of reliability and validity [12-24]. The ECOHIS has become a widely used tool for showing the impact of ECC on a child's quality of life.

Dental caries in preschool has been a health problem in Thailand for many years [25, 26]. Several strategies have been implemented to lower the prevalence of ECC, but two consecutive National Oral Health Surveys at 5-year intervals revealed that the prevalence remained high [25, 26]. Raising awareness of the impact of ECC on children in terms of parents' perceptions would be essential to help design more effective and suitable preventive strategies and interventions. Studies from many parts of the world had used ECOHIS as a tool and confirmed negative impact of ECC on quality of life [27]. However, not one tool in Thai was available to assess the oral health-related quality of life in young children in the Thai population. The most recent systematic review on advantages of instruments for oral health related quality of life (OHRQoL) measurement also demonstrated ECOHIS was the most robust tool among available instrument suitable for preschool children [28]. This study then aimed to translate the ECOHIS into the Thai language and validate the Thai version of the ECOHIS (Th-ECOHIS).

## Methods

The study protocol was approved by the Ethical Review Committee for Research in Human Subjects, Ministry of Public Health. Written informed consent was obtained from primary caregivers before they

participated in the study. The process of developing a Thai version of the ECOHIS consisted of two main phases; 1) translation, face and content validation, 2) psychometric testing (Figure 1).

The translation and cross-cultural adaptation process of the original ECOHIS into Thai version were followed international standards for the development of new linguistic versions [30, 31]. The original English version of ECOHIS was translated into Thai by two dentists with high English proficiency. A group of English-proficient Thai specialists in pediatric dentistry and public health who were also familiar with a quality-of-life assessment discussed each item in terms of its concept to see whether their concepts were consistent with those in the original version, until a first draft of the Thai version was reached. Face validation with the convenience sample was conducted in a group of 20 Thai mothers of 3- to 5-year-old kindergarten children in a Bangkok suburb in order to verify the first draft of Th-ECOHIS. The comments were utilized to improve each item. After a questionnaire interview, all participants were invited to discuss on the clarity and comprehensibility of each questionnaire item, the logic and relevance of the order of the items, and the understandability of the rating scale for answers. All comments once again were utilized to improve each item in the questionnaire to produce the second draft of Th-ECOHIS. To test the cross-cultural adaptation, the second draft was back translated by a bilingual dentist who was a native speaker of Thai and English; the original source of ECOHIS was kept unknown to him. The back-translated ECOHIS was compared with the original version, and the differences between the two versions were found to be minor; each item in the translated version was consistent with each item in the original version. The working group reconsidered and reviewed all the details of each process and finalized a Thai version of ECOHIS.

In the psychometric testing phase, the Th-ECOHIS was evaluated by assessing its reliability and validity. This phase was conducted under the Seventh Thailand National Oral Health Survey. The caregivers of healthy Thai 3-year-old children who were involved in the national survey of the Bangkok region were invited to participate in this study. To be included in the study, the child must be 3 years to 3 years 11 months of age who cooperated for dental caries examination. The proxy respondent must be parent or main caregiver who took primary responsibility for the child and Thai language literate. The only exclusion criteria was inability to complete the interview session.

The Th-ECOHIS questionnaire had two main parts containing a total of 13 items, as did the original. Nine items measured the impact of ECC on a child in four aspects: symptoms (1 item), function (4 items), emotional well-being (2 items), and self-image and social interaction (2 items). The other four items evaluated the impact on the family in two aspects: parental distress (2 items) and family function (2 items). Questions required parents/caregivers to recall how often they had observed their child and family encountering situations involving their child's oral health since the child was born. Responses were formatted in a simple five-point Likert-type scale, with answers ranging from Never (0) to Very Often (4); a response of Don't Know was an alternative response. To evaluate the convergent validity of the Th-ECOHIS questionnaire, one global oral health rating question was added to the questionnaire: In general, how would you rate the dental health of your child? The response codes were 1 = excellent, 2 = very good,

3 = good, 4 = fair, and 5 = poor. Our study hypothesized that children whose general oral health was rated as poor would get high scores on both parts of the Th-ECOHIS.

The main caregivers were interviewed with the structured Th-ECOHIS questionnaire by one interviewer and asked to provide demographic information. To avoid bias, the interviewer read the questions to the participants without explaining any of the questions or elaborating on any of the responses. For the rating scale, participants were shown a series of scale cards and asked to choose their response from the ones on the cards; their responses were then recorded by the interviewer. After 2 weeks, 10% of the caregivers were invited to a second interview at which they were asked the same questions.

The child's weight and height were measured as general health indicators. The oral health status of each child was indicated by the dental caries experience index and dental treatment need adopted from the Seventh Thailand National Oral Health Survey [26]. It was conducted by trained and calibrated examiners based on the World Health Organization basic criteria for the visual assessment of dental caries. The dental caries status of each child was classified into three groups by the number of decayed, missing, and filled teeth (dmft index): caries free; ECC (dmft 1 to 3); and severe ECC (dmft 4 or higher). The treatment needs were classified into three categories: no treatment need, one or more surface restoration, and pulp treatment and / or extraction.

## **Analyses**

The Th-ECOHIS scores were calculated as a simple sum of the response codes for the child impact section, family impact section, and overall questionnaire. The Don't Know response was recoded as a missing value. Our study managed the missing response by adapting the method proposed in the original version[8]. For subjects with up to two missing responses on the child impact section or one missing response on the family impact section, a score for the missing item was imputed as a median score of the remaining items for that section. Participants with more than two missing child items and one missing family item would be excluded from the analysis. The psychometric testing of the Th-ECOHIS was analyzed by assessing its internal consistency and test–retest reliability, as well as its convergent and discriminant validity.

The internal consistency reliability of the questionnaire was assessed for the child impact section, family impact section, and overall questionnaire using Cronbach's alpha coefficient. The test–retest reliability was assessed using the intraclass correlation coefficient (ICC) calculated by a two-way analysis of variance. The convergent validity was determined by computing the Spearman's rank-order correlations of the responses to the global question and each of the Th-ECOHIS sections and overall scores. The discriminant validity was tested by the Kruskal–Wallis test to compare the scores of the child impact section, family impact section, and overall questionnaire among children with different severities of caries experience and treatment need. The SPSS statistical package version 17 was used for data analysis. The level of statistical significance is set at a  $p$ -value < 0.05.

# Results

## Translation, face and content validation

All 13 items in the original ECOHIS were translated into Thai, incorporating cross-cultural concerns with an awareness of the lexical gaps between Thai and English. The translation was processed based on conceptual equivalence rather than linguistic/literal equivalence. Two versions from the blind parallel translation were compared and merged. The word *difficulty* has many variations in Thai when used in different contexts, for instance, the English phrase “difficulty pronouncing” would be translated as “speech sound errors” in Thai, and the English phrase “difficulty eating” would be translated as “hurt when chewing” in Thai. This made the back-translation slightly difficult. All 13 questions from the original ECOHIS were kept in the Thai version and the order of questions were rearranged following the process of face validity. In the psychological section, the oral problem causing *irritability or frustration* was moved to follow the symptomatic “pain” question because both were concerned with a child’s suffering related to dental problems. In the functional section, the first question involved “missing school” because this occurrence would be the most memorable and easiest to recall because of its importance in Thai culture.

## Psychometric testing

A total of 240 child–caregiver pairs were recruited, and 214 pairs completed the data for analysis. Sixteen pairs were excluded because their caregivers had limited time to complete the Th-ECOHIS questionnaire. Of the 214 caregivers, 65.4% (n = 140) were mothers, 75.2% (n = 161) were from families with an average income, and 97.6% were Buddhists. All children were healthy, most had weight (88.3%) and height (92%) appropriate to age (2SD) [32]. The mean (SD) age of the children was 42.93 (2.86) months, ranged from 36 to 48 months. Of the 214 children, 50% were boys, 60.7% were caries-free and 17.3% had severe ECC (dmft 4 or higher). The mean (SD) dmft score was 1.63 (2.92). The demographic information of the children and their proxy respondents is shown in **Table 1**.

All of the proxy respondents completed the questionnaires with no blank items and no more than one Don’t Know response item for each child. The distribution of the proxy responses to the Th-ECOHIS items related to a child’s oral health problems is shown in **Table 2**, and the descriptive distribution by section is summarized in **Table 3**. The maximum scores of the Th-ECOHIS were 27 of 36 in the child impact section and 12 of 16 in the family impact section. The ceiling effect was negligible for each item and the total score. Two respondents answered Don’t Know to the item “child avoided talking,” and two respondents answered Don’t Know to the item “family member felt guilty.”

Overall, 55.1% of caregivers reported that at least one aspect related to a child’s oral health had affected their children and family (**Table 3**). The percentage of proxy respondents reporting that oral health problems had affected their family (46.3%) was higher than those reporting that they had affected their children (36.9%). The three most prevalent response in the child impact section was “pain in the teeth, mouth, or jaws” (26.6%), followed by “became irritable or frustrated” (25.7%) and “difficulty in eating

some foods” (16.8%). In the family impact section, the two most frequently reported impacts were “parents or family members feeling guilty” (46.3%) and “being upset” (36.9%).

The overall reliability of the Th-ECOHIS showed good results (**Table 4**). The mean inter-item correlations (Cronbach’s alpha coefficient) of the total ECOHIS items, child impact section, and family impact section were 0.85, 0.84, and 0.71, respectively. The test–retest reliability scores (intraclass correlation coefficient, ICC) of the Th-ECOHIS were 0.87 for the total of the items, 0.78 for the child impact section, and 0.87 for the family impact section.

The construct validity was analyzed using the Spearman correlation coefficient and showed a moderate correlation for the global oral health rating and total Th-ECOHIS score ( $r = 0.604$ ;  $p < 0.01$ ) (**Table 5**). The discriminant validity was assessed by comparing the Th-ECOHIS scores for the severity of caries experience and dental treatment need. Variations in the ECOHIS and the two subscale scores (child impact and family impact sections) ( $p < 0.001$ ) were apparent among different caries status (**Table 6**). Children with caries had higher ECOHIS scores than caries-free children, Children with severe ECC had significantly higher Th-ECOHIS scores than children with ECC did. Differences of the Th-ECOHIS among treatment need categories were significant ( $p < 0.001$ ). Children who had dental treatment need had a higher Th-ECOHIS score than those who had not. (**Table 6.**)

## Discussion

This study is the first attempt to deploy a valid cross-cultural instrument used effectively in many countries worldwide to measure OHRQoL of preschool children in Thailand. ECOHIS focuses on the impact of ECC, which has been a major health problem in Thai preschoolers. The most recent National Oral Health Survey in Thailand in 2017 revealed that the prevalence of ECC was 52.9% in 3-year-olds and 75.6% in 5-year-olds [25]. An assessment of the impact of these oral health problems on children’s quality of life has never been conducted. The ECOHIS has been adapted for use in some Asian populations with a similar ECC situation as in Thailand [15, 18]. The Thai version of ECOHIS was developed from the original version following the standard cross-cultural adaption process [30,31]. All 13 items of the original ECOHIS were retained, and thus the Th-ECOHIS could be employed in cross-national comparisons. However, some minor revisions were made to be more applicable when used in Thai context.

The original version of the ECOHIS was developed as a self-completed questionnaire by proxy [8]. Although the Th-ECOHIS kept the original context, it was interviewer-administered. The interview approach was considered suitable for the studied population because it is a personal approach, ensures full return rates, lessens the possibility of missing data, and is non-literacy dependent. Although the literacy rate of working-age adults in Thailand is about 82%, the literacy rates of females and older persons are lower, at 78% and 52%, respectively [33]. One third of Thai adults aged 25 to 50 years are not fond of reading [33]. This was confirmed during the face validation process, when the mode of administration was discussed; the participants preferred the interviewing mode because they felt it would help them focus on the questions and process them better. The Brazilian version of ECOHIS had similar

levels of reliability and validity and psychometric findings regarding self-administration and interviewer-administration [23]. Studies using other OHRQoL instruments demonstrated that the mode of administration does not affect the performance of the measure [34, 35].

Most of the caregivers who participated in this study were able to rate their children's and family's experience as asked in the Th- ECOHIS. The fact that there were only four responses of Don't Know (1%) shows that few of the caregivers had underestimated the effects of ECC. There were no blank responses in our study because with the interview-administration mode encouraged respondents to answer each question. Approximately one half of caregivers reported at least one impact on their children and families (Th-ECOHIS score > 0). The ceiling Th-ECOHIS score of each section was not detected, and this was consistent with other validation studies [8, 14, 15, 17, 22]. Regarding the floor effect, our study showed a higher rate in the child impact section than the original study [8] contributed by the lower percentage of affected children in this study. The participants recruited in this study were limited to 3-year-olds, whereas the original study included samples of 5-year-olds [8]. The younger age group could have been less affected by ECC, with a lower level of severity causing fewer symptoms and less impairment than the older age group. However, the three most common problems reported in the child impact section, pain, irritation and frustration, and eating difficulty, were similar to those reported in the original version [8] and other countries with different cultures [15, 19, 23]. Apparently, a child's physical complaints and limited routine functioning were more easily detected by parents than a child's psychological and social effects. In the family impact section, as in some other studies [8, 15, 19, 23], the most frequent feelings of caregivers were guilt and being upset. Although dental insurance is not available in Thailand, most simple dental services are provided free of charge for children younger than 12 years; only 10% of caregivers reported experiencing a financial impact on their family.

The reliability assessment of the Th-ECOHIS demonstrated an excellent result similar to the original version and previous studies. The test-retest analysis was conducted over a period of 2 weeks revealed good agreement (0.87), indicating that the Th-ECOHIS questionnaire was able to yield stability scores when administered at two different times. The ICC value was similar to that reported in the original English, German, and Farsi versions of the ECOHIS (0.84, 0.81, and 0.82, respectively) [8, 12, 14].

Regarding the consistency of results across items within questionnaire, the overall Cronbach's alpha value was 0.85, demonstrating good internal reliability of Th-ECOHIS. This value was slightly lower than that reported in the original English [8] and German versions [12] but was within the same range reported in the Arabic, Brazilian, Lithuanian, and Malay versions [14, 15, 17, 23]. Comparing the internal consistency of the child impact section and the family impact section, the Cronbach's alpha coefficient in the family impact section (0.71) was lower than that in the child impact section (0.84). This was similar to previous studies in which the internal consistency in the child impact section and the family impact section ranged from 0.74 to 0.92 and 0.59 to 0.85, respectively. The smaller number of items in the family impact section in Th-ECOHIS might have been one of the factors influencing this lower consistency.

To assess the Th-ECOHIS validity, convergent and discriminant analyses were conducted. Both analyses showed that the Th-ECOHIS had good validity. Our study used the global measure of oral health to assess the convergent validity of the Th-ECOHIS. This measure is commonly used as a subjective indicator and has been demonstrated to be highly correlated with the clinical oral health status [35]. The Th-ECOHIS showed a moderate correlation with the global measure of oral health. The correlation of our finding was higher than in the original version [8] and was comparable with the Turkish and Brazilian versions [22, 23]. This finding showed that parents who perceived their children's oral health as poor tended to have a higher ECOHIS score.

In the discriminant validity analysis, our study compared the Th-ECOHIS scores among children different caries status and treatment need. The results clearly suggested the Th-ECOHIS score could be a valid indicator for compromised quality of life of children by different severity of caries and treatment need. Children with more severe caries category and treatment need had higher both total and sub-section scores. Other studies found that the treatment need that affect quality of life of children were those related to pulpal involvement and pain [24, 37], however, in our study even non-pulpally involved treatment need showed an effect on children OHRQoL. This also implied that parents are reliable for assessment of their child's quality of life based on the child's oral health. It was also noted that the ECOHIS scores were reported for the child and family impact sections even in caries-free children. ECOHIS might be able to detect other oral problems not limited to dental caries.

The original ECOHIS aimed to assess the impact of both oral health problems and related treatment experiences on the quality of life of preschool children and their families [8]. Most studies using a translated form of ECOHIS focused on a mixed-age group of preschoolers and the original focused only on 5-year-olds [8]. However, our study included only 3-year-olds, which this group evidently had a consistently high prevalence of ECC, for psychometric analysis [25, 26]. The caries prevalence of Bangkok metropolitan children, according to the most recent national survey, is 49.5% in 3-year-olds and increases to 66.1% in 5-year-olds, a percentage slightly lower than overall in Thailand. Because a full response from caregivers could be achieved with the design of the interview-administered questionnaire, the age group of the children might not have affected the validity and reliability of the study. However, it might affect the magnitude of the impact of oral health problems, which was not an objective of our study. The ECOHIS was proved valid for this particular age group. However, it was carried out in specific group of children in the capital city from homogeneous SES middle-income families. Further studies in different age groups and diversity of background would help strengthen our results. Although some studies demonstrated that the mode of administration does not affect the measuring performance [23, 34, 35], self-administration has more advantages in terms of lower cost, the preservation of participants' anonymity and autonomy, avoidance of interviewer bias, and availability for a large number of samples. The Th-ECOHIS questionnaire in self-completed mode should be tested in future studies. In addition, our study limited the socio-demographic characteristics of caregivers to relationship to the child and monthly income per household; age and level of education of caregivers were not collected.

Future studies would also find it noteworthy to include more general health parameters such as perceived general health, general health behaviors, children's weight and height for convergent validity testing of this scale. However, those parameters at this young age with limited ECC severity might not show a correlation or an impact on OHRQoL as in this study, all child samples were healthy, and no any growth alteration was seen through their normal weight and height.

It could also add to the study limitation that classical test theory (CTT) was used for psychometric testing of the scale in this study, similar to many previous studies (12-24). All versions have kept all items as the original. This would be useful in across countries comparison of children OHRQoL measured by different versions of ECOHIS. The CTT treats all questions equally, it contributes to simpleness in analysis and familiarity in dentistry. However, it would be useful to further analyze the translated version using item response theory (IRT) such as Rasch analysis [38,39]. It would help detect any misfit item considered in modification or shortening the scale to customize specifically for Thai population.

This patient-based outcome measure will be a very useful parameter in demonstrating compromised quality of life in variety groups of preschool children. It could be incorporated in the national oral health survey. The illustration of deleterious effect of ECC would raise awareness of caries prevention in parents and families. It could help improve communication among dentists, patients and policy makers. Future study on responsiveness of Th-ECOHIS would be necessary prior to apply the tool as a metric parameter in evaluation of various intervention program in ECC affected children.

## **Conclusion**

The overall psychometric evaluation of the Th-ECOHIS was demonstrated to be valid and reliable for evaluating the impact of oral health problems on the quality of life of Thai preschool children and their families. The Th-ECOHIS can be used in cross-cultural comparisons with worldwide languages translated ECOHIS studies.

## **Abbreviations**

ECC: Early childhood caries; ECOHIS: Early childhood oral health impact scale; Th-ECOHIS: Thailand version of early childhood oral health impact scale; dmft: decayed, missing and filled teeth; SD: standard deviation; OHRQoL: Oral health related quality of life; ICC: intraclass correlation coefficient.

## **Declarations**

### **Ethics approval and consent to participate**

The protocol was approved by the Ethical Committee of the Ministry of Public Health of Thailand (DOH 2012-014). Informed consent was obtained from all participating caregivers.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

### **Completing interests**

The authors declare that they have no completing interests.

### **Funding**

None.

### **Authors' contributions**

All authors actively participated in the study and made substantial contribution to this article. PL conceptualized the rationale and design of the study, involved in the translation process, drafted and wrote the manuscript. VJ contributed to the study design, involved in the translation process, conducted the statistical analyses, interpreted the results, drafted and wrote the manuscript. CU and WV contributed to the study design, data collection and field work management. All authors read and approved the final manuscript.

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## Tables

Table 1 Demographic data of children and proxy respondents.

	Total	Caries free	ECC (dmft 1-3)	Severe (dmft ≥4)	<i>p</i> -value*
	N (%)	n (%)	n (%)	n (%)	
Number of child-caregiver pairs	214 (100%)	130 (60.7%)	47 (22.0%)	37 (17.3%)	
Child demographic data					
Gender					0.389
Male	107 (50.0)	64 (49.2)	21 (44.7)	22 (59.5)	
Female	107 (50.0)	66 (50.8)	26 (55.3)	15 (40.5)	
Mean age (month)(SD)	42.93 (2.86)	42.98 (2.84)	42.94 (2.93)	42.70 (2.92)	0.870
Min - Max	36 - 48	38-48	38-48	37-48	
Proxy demographic data					
Relationship to the child					
Mother	140 (65.4)	88 (67.0)	30 (63.8)	22 (59.5)	0.449
Father	47 (22.0)	24 (18.5)	11 (23.4)	12 (32.4)	
Others	27 (12.6)	18 (13.8)	6 (12.8)	3 (8.1)	
Monthly family income**					0.043
Low income (< 20,000 bath)	38 (17.76)	19 (14.6)	15 (31.9)	4 (10.8)	
Average income (20,000 – 50,000 bath)	161 (75.23)	100 (76.9)	31 (66.0)	30 (81.1)	
High income (> 50,000 bath)	15 (7.01)	11 (8.5)	1 (2.1)	3 (8.1)	

Note \* comparison among caries free, ECC and severe ECC group

\*\* According to The National Statistics Office household income survey (by type of occupation) in Bangkok 2011 [29]

Table 2 Distribution of the proxy responses to the Th-ECOHIS items related to child's oral health problems

	Never n(%)	Hardly ever n(%)	Occasionally n(%)	Often n(%)	Very often n(%)	Don't know n(%)
<b>Child impacts</b>						
How often has your child had pain in teeth, mouth or jaws?						
	157 (73.4)	25(11.7)	24(11.2)	7(3.3)	1(0.5)	0(0)
How often has your child... because of dental problems or dental treatments?						
had difficulty drinking hot or cold beverages	200(93.5)	7(3.3)	3(1.4)	3(1.4)	1(0.5)	0(0)
had difficulty eating some foods	178(83.2)	14(6.5)	10(4.7)	8(3.7)	4(1.9)	0(0)
had difficulty pronouncing any words	193(90.2)	3(1.4)	7(3.3)	9(4.2)	2(0.9)	0(0)
Missed preschool, daycare or school	204(95.3)	4(1.9)	3(1.4)	3(1.4)	0(0)	0(0)
had trouble sleeping	183(85.5)	16(7.5)	11(5.1)	4(1.9)	0(0)	0(0)
Been irritable or frustrated	159(74.3)	26(12.1)	22(10.3)	7(3.3)	0(0)	0(0)
avoid smiling or laughing	204(95.3)	7(3.3)	1(0.5)	2(0.9)	0(0)	0(0)
avoid talking	206(96.3)	2 (0.9)	1(0.5)	3(1.4)	0(0)	2(0.9)
<b>Family impacts</b>						
How often have you or another family member...because of your child's dental problems or treatment?						
been upset	130(60.7)	22(10.3)	28(13.1)	34(15.9)	0(0)	0(0)
felt guilty	127(59.3)	19(8.9)	26(12.1)	36(16.8)	4(1.9)	2(1.0)
take time off from work	194(90.7)	11(5.1)	4(1.9)	5(2.3)	0(0)	0(0)
How often has your child had dental problems or dental treatment that had a financial impact on your family?						
	193(90.2)	7(3.3)	9(4.2)	4(1.9)	1(0.5)	0(0)

Table 3 Descriptive distribution of the Th- ECOHIS by sections.

Impacts	Number of items	Possible range	Range	Floor effect (%score0)	Mean (SD)	Median IQR
Child impact section	9	0-36	0-27	63.1	2.05(3.94)	0(3)
Child symptoms	1	0-4	0-4	73.4	0.46(0.853)	0(1)
Child function	4	0-16	0-12	77.1	0.80(1.926)	0(0)
Child psychology	2	0-8	0-6	72.0	0.66(1.307)	0(1)
Self-image and social interaction	2	0-8	0-6	93.9	0.13(0.693)	0(0)
Family impact section	4	0-16	0-12	53.7	2.10(2.783)	0(4)
Parental distress	2	0-8	0-6	55.1	1.75(2.264)	0(4)
Family function	2	0-8	0-6	85.5	0.35(1.018)	0(0)
All sections	13	0-52	0-39	44.9	4.15(5.980)	2(6)

Table 4 Reliability analyses of the Th-ECOHIS: internal consistency and test-retest reliability

Impact	Internal consistency	Test- retest reliability [ICC] (95% CI)]
	Cronbach's alpha	
Child impact section	.842	.78 (.40, .92)
Family impact section	.706	.87 (.64, .95)
All sections	.854	.87 (.63, .95)

Intraclass correlation coefficient (two-way mixed effects model)

Table 5 Convergent validity of the Th-ECOHIS.

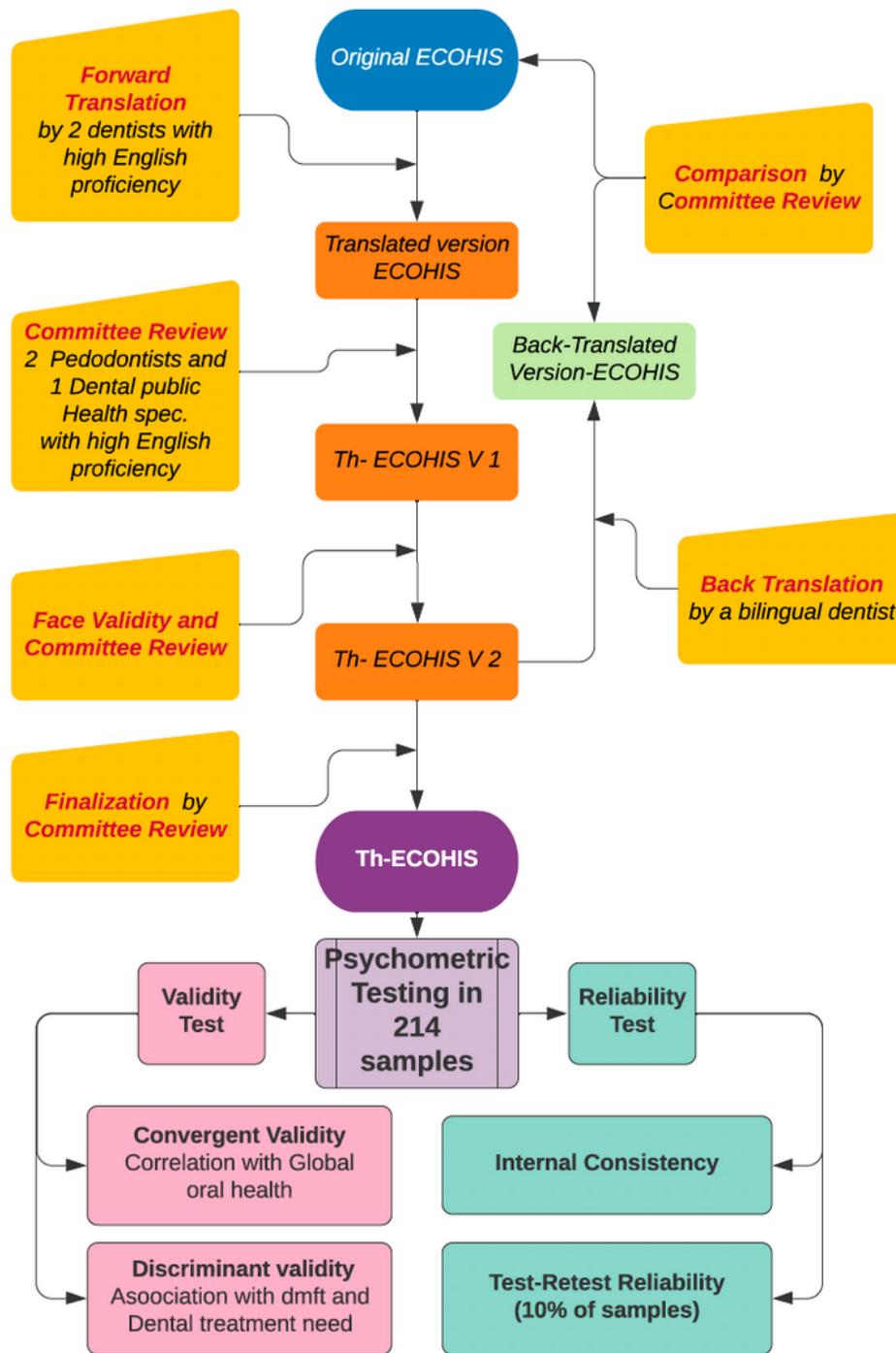
	Child impact	Family impact	Total score
Global oral health rating	0.423*	0.622*	0.604*

\*  $p < 0.01$

Table 6 Discriminant validity of the Th-ECOHIS.

Caries experience	Caries-free (n=130)	dmft 1-3 (n=47)	dmft ≥4 (n=37)	p-value
<b>Child impact section</b>				
Mean(SD)	1.30(3.68)	2.47 (3.43)	3.97(4.69)	
Median (IQR)	0(0)	1(4)	3(7)	< 0.001
<b>Family impact section</b>				
Mean(SD)	1.52(2.59)	2.45(2.51)	3.68(3.16)	
Median (IQR)	0(2)	2(4)	4(6)	< 0.001
<b>All sections</b>				
Mean(SD)	2.51(4.13)	4.74(4.83)	7.65(7.05)	
Median (IQR)	0(4)	4(8)	7(11)	< 0.001
Treatment need	No treatment (n=130)	Need filling (n=65)	Need pulp treatment / extraction (n=19)	p-value
<b>Child impact section</b>				
Mean(SD)	1.18(3.47)	3.29(4.51)	3.68(3.38)	
Median (IQR)	0(0)	1(6)	3(7)	< 0.001
<b>Family impact section</b>				
Mean(SD)	1.45(2.60)	3.05(2.96)	3.32(2.11)	
Median (IQR)	0(2)	3(6)	4(3)	< 0.001
<b>All sections</b>				
Mean(SD)	2.64(5.25)	6.34(6.78)	7.00(4.49)	
Median (IQR)	0 (4)	5(12)	8(7)	< 0.001

## Figures



**Figure 1**

Cultural - adaptation and translation process and psychometric investigation