Translation and Validation of the Psychometric Properties of the Convergence Insufficiency Symptom Survey in Thai Version

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Abstract

The convergence insufficiency symptom survey (CISS) is a tool to describe the association between convergence insufficiency and its symptoms; however, no Thai language version of the test is available. The aim of this study was to translate the CISS original version into a Thai language version and to assess the psychometric properties of the test. Cross-cultural adaptation was used to facilitate the translation process. Validation of the CISS in Thai version (CISS-tv) used index of item objective congruence (IOC) evaluated by an expert committee. The pretesting to assess the consistency reliability was conducted on two different occasions. Results showed that the IOC score was 1 for 8 items, 0.67 for 4 items, 0 for 2 items, and -0.33 for 1 item. The IOC score was lower than the acceptable value (0.5) for 3 items, which were modified before being applied with forty participants aged 20–24 years (22.75 ± 1.32 years). The CISS-tv showed good internal consistency with Cronbach's alpha of the test at 0.895. The intraclass correlation coefficient of test and re-test reliability was 0.964. Pearson's correlation coefficient between the test and re-test total scores was 0.934 ($p < 0.001$). These findings suggest that the CISS-tv has good content validity and high reliability. It is therefore an effective diagnostic tool to use in clinical and research applications for convergence insufficiency or near visual problems in the Thai population.

Keywords*: *Convergence insufficiency, Symptom survey, Content validity, Reliability

1. Introduction

Convergence insufficiency (CI) is a common non-strabismic binocular vision problem. Its diagnostic criteria require comprehensive vision examination with numerous functional tests of binocular vision. The CI prevalence has varied throughout different studies and textbooks. Individuals with CI could have significantly recognizable signs and symptoms: receded near point of convergence (NPC), greater exophoria at near than at distance, decreased positive fusional convergence (PFC), and a low accommodative convergence to accommodation (AC/A) ratio (Gantz & Stiebel-Kalish, 2022). In Thailand, there is less clear evidence of CI prevalence among any population groups. Normally, the CI symptoms associated with reading and near work, about which most patients would have significant complaints, include headaches and eyestrain after reading or doing near work, diplopia or blurred vision, sleepiness, reading comprehension problems, and loss of concentration while reading (Cooper & Jamal, 2012; Scheiman & Wick, 2013; Gantz & Stiebel-Kalish, 2022).

The convergence insufficiency symptom survey (CISS) is a diagnostic tool used to describe the association between the problems of CI and its

symptoms, and to conduct screening, identifying, and monitoring of CI therapy (Convergence Insufficiency Treatment Trial Study, 2008; Barnhardt, Cotter, Mitchell, Scheiman, & Kulp, 2012; Horwood, Toor, & Riddell, 2014). The CISS was developed by the convergence insufficiency reading study (CIRS) group and later revised by the convergence insufficiency treatment trial (CITT) group. CISS validity and reliability were investigated with children and adults having ages ranging from 9 to 30 years old. Subsequently, the cutoff points used are ≥16 for children and ≥21 for adults, and the total possible test score is 60 (Borsting et al., 2003; Rouse et al., 2004; Rouse et al., 2009). Previously, the CISS has been translated and adapted into Portuguese (Tavares, Nunes, Nunes, Pato, & Monteiro, 2014), Spanish (Gonzalez-Perez, Perez-Garmendia, Barrio, Garcia-Montero, & Antona, 2020), Persian (Nabovati, Kamali, Khabazkhoob, Mirzajani, & Jafarzadehpur, 2020) and Italian versions (Boccardo et al., 2023), in which the standard guidelines were used for the cross-cultural adaptation process (Beaton, Bombardier, Guillemin, & Ferraz, 2000; Gjersing, Caplehorn, & Clausen, 2010). In Thailand, there has been no concrete attempt to translate the CISS test into the Thai language for use with the Thai population. Therefore, the aim of this study was to translate the CISS from the original English into a Thai version and to assess its psychometric properties.

2. Objectives

To translate the original English version of the convergence insufficiency symptom survey into a Thai language version and to assess the psychometric properties of the test.

3. Materials and Methods

3.1 Translation process

The translation process was divided into two stages (Figure 1). Stage I involved the forward translation of the original English language version of the convergence insufficiency symptom survey (CISS-ev) into the Thai language by the research team based on the cross-cultural adaptation process recommended in several studies (Beaton et al., 2000). The CISS-ev contains 15 questions with score levels of symptoms ranging from 0 to 4. A score of 0 is selected if the respondent has never had an indicated symptom, a score of 1 if the symptom occurs infrequently, a score of 2 if the symptom has occurred occasionally, a score of 3 if the symptom occurs fairly often, and a score of 4 if the symptom always occurs. The total score of 60 indicates that all symptoms are always present. Stage II was conducted to ensure that the meaning of the content was not changed, and back translation of the CISS Thai language to English language was performed.

3.2 Validation process

The questionnaire of the convergence insufficiency symptom survey in Thai version (CISS-tv) was reviewed by an expert committee to assess the content validity in stage III. The validation of the CISS-tv was performed by the index of item objective congruence (IOC) test according to the previous guidelines (Turner, & Carlson, 2003; Kasa, Worakajit, Sinsen, & Samnieng, 2022). The IOC test is a tool to assess the content validity and consists of the standard IOC form containing the 15 questions of the CISS-tv and the level scores of the IOC test. An IOC score of 1 is given if CISS-tv is correct and consistent with CISS-ev, a score of 0 is given if unsure, and score of -1 is given if it is incorrect or inconsistent. Thus, the CISS-tv was evaluated by a relevant expert committee with three members: one optometrist, one researcher, and one English linguist.

3.3 Participants and Reliability process

This study was approved by the Research Ethics Committee of Ramkhamhaeng University (RU) (code: RU-HRE 66/0136), and informed consent and an information sheet for research participants were explained and then signed by all participants. Forty adults, both male and female, between the ages of 20 and 24 years were enrolled for the study. Inclusion criteria were being a healthy person and native Thai speaker. Participants meeting the inclusion criteria were expected to participate in the pretesting (stage IV). The final CISS-tv questionnaire (Appendix 1) was addressed by all participants specifically two times with a pause in between each time of about 1 week to assess the internal consistency using Cronbach's alpha and the intraclass correlation coefficient (ICC).

3.4 Statistical analysis

The IOC test was used to assess the content validity, in which the IOC scores were given by the relevant expert committee and analyzed using the Microsoft Excel program. The acceptable value of the IOC scores from the three expert committee members was greater than 0.5. For reliability analysis, the internal consistency (Cronbach's alpha) and ICC using IBM SPSS software, version 29.0.0.0 (Computer Institute of Ramkhamhaeng University) were applied. The value of Cronbach's alpha coefficient greater than 0.70 was regarded as acceptable. The internal consistency reliability analysis used the ICC with the confidence interval set at 95%, and the Pearson's correlation between test and re-test total scores was investigated. The results were considered statistically significant if $p < 0.05$.

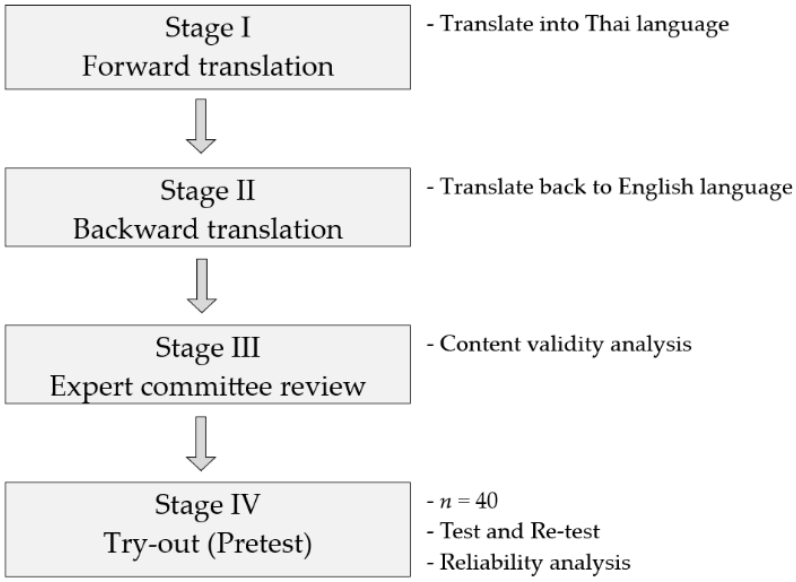

Figure 1 Stages of translation and cross-cultural adaption

Table 1 Descriptive data of participants (n = 40)

	N	%	Mean age (SD)
Participants			
Undergraduate students at RU* aged 20–24 years old	40	100	22.75 (± 1.32)
Sex			
Male	8	20	
Female	32	80	

*RU = Ramkhamhaeng University; SD = standard deviation

4. Results and Discussion

4.1 Results

4.1.1 Content validation of CISS-tv

The 15 questions of CISS-tv were evaluated by the expert committee to assess the content validity using the index of item objective congruence (IOC) test. Three expert committee members evaluated each item by giving scores with a rating of 1 if the CISS-tv was correct and consistent with the CISS original English version, a score of 0 if unsure, and a score of −1 if incorrect or inconsistent. The total score of each item that was given by the expert committee was calculated by the IOC = ∑R/n solution, in which R = sum score of each item, and n = sum of the total expert committee. An IOC score for each item greater than 0.5 was considered an acceptable value by the expert committee.

Our results showed that the CISS-tv IOC score was 1 for 8 items: item 1, item 2, item 3, item 5, item 7, item 8, item 10, and item 12; the IOC score was 0.67 for 4 items: item 4, item 11, item 13, and item 15; the IOC score was 0 for 2 items: item 6, and item 14; and the IOC score was -0.33 for 1 item: item 9 (Table 2 and Table 3). These results showed that the IOC score was lower than the acceptable value (0.5) for 3 items, which include the IOC score of 0 for items 6 and 14 and an IOC score of -0.33 for item 9 (Table 3). However, these three items of CISS-tv were modified according to the expert committee' recommendation before stage IV.

Table 2 Content validity of Convergence Insufficiency Symptom Survey in Thai version (CISS-tv)

Item	IOC* score given by three expert committee members				IOC = ΣR/n*
	1	2	3	Total score	
1	1	1	1	3	1
2	1	1	1	3	1
3	1	1	1	3	1
4	1	0	1	2	0.67
5	1	1	1	3	1
6	1	-1	0	0	0
7	1	1	1	3	1
8	1	1	1	3	1
9	1	-1	-1	-1	-0.33
10	1	1	1	3	1
11	1	0	1	2	0.67
12	1	1	1	3	1
13	1	1	0	2	0.67
14	1	0	-1	0	0
15	1	1	0	2	0.67

*IOC = Index of Item Objective Congruence; R = sum score of each item; n = sum of total expert committee

Table 3 Index of Item Objective Congruence (IOC) score of CISS-tv

IOC score	Number of items (total = 15)	100%
1	8 (items: 1, 2, 3, 5, 7, 8, 10, 12)	53.33
0.67	4	26.67

	(items: 4, 11, 13, 15)	
0	2 (items: 6, 14)	13.33
-0.33	1 (items: 9)	6.67

4.1.2 Reliability statistical analysis of CISS-tv

The questionnaire of the revised CISS-tv, as shown in Appendix 1, was addressed by all participants to evaluate its reliability. The CISS-tv revised version was conducted with forty adult participants (mean age 22.75 ± 1.32 years): 32 (80%) females and 8 (20%) males (Table 1). Our results showed that internal consistency with Cronbach's alpha of the first test (test) = 0.895 and the second test (re-test) = 0.925. The corrected item total correlation and the Cronbach's alpha if Item Deleted of test and re-test are shown in Table 4. The intraclass correlation coefficient (ICC) of test and re-test reliability was 0.964 (Table 5). The Pearson's correlation coefficient between test and re-test total score was 0.934 ($p < 0.001$) with a mean score of 19.5250 (SD ± 9.33696) and 19.8000 (SD ± 10.09239), respectively. The correlation between the test and re-test of CISS-tv of each item was statistically significant with $p < 0.001$ in all items (Table 6).

These results indicate that the CISS-tv revised version has very good psychometric properties that exhibit high values of Cronbach's alpha and ICC. All items of the revised CISS-tv showed a high value of Cronbach's alpha if Item Deleted. This indicates that each item of the CISS-tv is a qualified question and could not be deleted in any item. The revised version of the CISS-tv also showed a high value of Pearson's correlation coefficient between test and re-test total score with the mean scores of test and re-test being similar. This suggests that the revised CISS-tv possesses very good reliability.

Table 4 Reliability analysis of CISS-tv

	Cronbach's alpha of Test 0.895		**Cronbach's alpha of Re-test** 0.925	
Item	**Corrected Item Total Correlation**		**Cronbach's alpha if Item Deleted**	
	Test	**Re-test**	**Test**	**Re-test**
1	0.555	0.685	0.889	0.918
2	0.727	0.675	0.883	0.919
3	0.650	0.814	0.885	0.914
4	0.588	0.726	0.887	0.917
5	0.610	0.776	0.886	0.916
6	0.407	0.655	0.895	0.919
7	0.336	0.502	0.896	0.924
8	0.514	0.575	0.891	0.922
9	0.536	0.713	0.889	0.918
10	0.449	0.383	0.892	0.927
11	0.700	0.665	0.883	0.919
12	0.504	0.691	0.891	0.918
13	0.623	0.636	0.886	0.920
14	0.659	0.627	0.884	0.920
15	0.679	0.555	0.883	0.923

Table 5 ICC* and Pearson's correlation between Test and Re-test total score

ICC of total score between Test and Re-test	Pearson's correlation between Test and Re-test total score	Test	Re-test
		Mean (SD)	Mean (SD)
0.964 (CI 0.933 to 0.981)	0.934 ($p < 0.001$)	19.5250 (9.33696)	19.8000 (10.09239)

*ICC = Intraclass correlation coefficient; CI = Confidence Interval; SD = standard deviation

Table 6 Correlations between Test and Re-test of CISS-tv of each item

Item	Test and Re-test correlation of each item	*p*-value	Test		Re-test	
			Mean	SD	Mean	SD
1	0.570	< 0.001	2.0000	0.84732	1.9500	1.06096
2	0.691	< 0.001	1.6000	0.84124	1.6250	0.83781
3	0.708	< 0.001	1.4750	1.10911	1.4250	1.00989
4	0.775	< 0.001	1.8250	0.98417	1.5750	1.00989
5	0.653	< 0.001	1.5250	1.03744	1.4250	0.87376
6	0.525	< 0.001	1.6000	1.08131	1.2750	1.01242
7	0.622	< 0.001	0.7000	0.85335	0.9500	0.98580
8	0.598	< 0.001	0.3500	0.69982	0.5500	0.81492
9	0.798	< 0.001	1.0250	0.91952	1.2750	0.93336
10	0.593	< 0.001	0.8000	0.88289	1.0250	0.89120
11	0.541	< 0.001	1.5500	1.01147	1.5500	0.93233
12	0.560	< 0.001	1.4000	0.98189	1.4250	1.03497
13	0.613	< 0.001	1.2000	0.99228	1.3250	0.94428
14	0.779	< 0.001	1.1000	1.21529	1.1250	1.04237
15	0.703	< 0.001	1.3750	1.10215	1.3000	1.04268

*SD = standard deviation

4.2 Discussion

The CISS original English version was adapted and translated into a Thai language version (CISS-tv) according to the guidelines for the cross-cultural adaptation process (Beaton et al., 2000; Gjersing et al., 2010). Validation of the CISS-tv was done using the index of item objective congruence (IOC) test (Turner & Carlson, 2003), in which scores were given by the three relevant expert committee members: one optometrist, one researcher, and one English linguist. The acceptable value for each item was greater than 0.5. Our results showed the IOC score of CISS-tv passed for 12 items with scores greater than 0.5 for each item whereas three items had scores less than 0.5, which included item 6, item 9, and item 14 (Table 3). For these three items of CISS-tv with IOC scores less than 0.5, they are not considered as Item Deleted, but were modified according to the expert committee's recommendations before being applied with the subjects and reliability analysis. The three items scoring less than 0.5 are possibly a result of there being only one optometrist on the committee who understands the symptoms of convergence insufficiency (CI). Although the CISS-tv questionnaire was revised, it has very high internal consistency and intraclass correlation coefficient (ICC) as shown in Table 4 and Table 5, respectively.

The reliability analysis results of the CISS-tv revised version show a good internal consistency with Cronbach's alpha = 0.895 and very high value of ICC = 0.964 with 95% confidence interval 0.933 to 0.981. In addition, we assessed the Pearson's correlation coefficient between test and re-test total score, which is 0.934 and statistically significant ($p < 0.001$). These results indicate that the revised CISS-tv has an excellent internal consistency, correlation and test-retest reliability (Perinetti, 2018). The internal consistency and ICC value of CISS-tv revised version was higher than the CISS original English version that was applied with

adults aged 19–30 years old (mean age 24.3 ±3.6) (Cronbach's alpha = 0.845) (ICC = 0.885) (Rouse et al., 2004). When compared with the previous research, Cronbach's alpha and ICC values of CISS-tv revised version are similar to most prior studies, such as the Portuguese (Cronbach's alpha = 0.893) (ICC=0.924) (Tavares et al., 2014), Italian (Cronbach's alpha = 0.89) (ICC = 0.92) (Boccardo et al., 2023), and Spanish versions (Cronbach's alpha = 0.85) (ICC = 0.878) (Gonzalez-Perez et al., 2020). This indicates that the revised CISS-tv is a valid and reliable tool equal to other versions for use in the clinical and research applications of CI or near visual skill problems.

We also examined the mean score of revised CISS-tv which was shown as mean score 19.5250 (SD ± 9.33696) for the first test and 19.8000 (SD ± 10.09239) for second test with the age of participants at 20 to 24 years (mean age 22.75 ± 1.32). The results revealed that the mean scores obtained from the pretesting at two different times were not changed. These findings indicate that the CISS-tv revised version has strong statistical reliability as represented by the ICC value and Pearson's correlation coefficient. The mean score of the revised CISS-tv is different from the previous studies that examined translation and cross-cultural adaptation of the CISS original version, for example, the Portuguese version with mean score 15.56 ± 8.86 for subjects aged 18–30 years (mean age 21.79 ± 2.42) (Tavares et al., 2014), the Italian version with mean score 16.1 ± 8.8 for subjects aged 18–29 years (mean age 21.8 ± 2.2) (Boccardo et al., 2023), the Spanish version with mean score 15.10 ± 10.13 for subjects aged 9–30 years (mean age 15.92 ± 5.59) (Gonzalez-Perez et al., 2020), and the Persian version with mean score 31.86 ± 3.91 for subjects aged 18–34 years (mean age 25.70 ± 5.26) (Nabovati et al., 2020). These indicate that the mean scores are varied with the age of the subjects although all of these studies have shown a high value of the internal consistency and ICC as explained above.

5. Conclusion

The CISS-tv questionnaire is an effective screening tool with high validity and reliability. It shows high internal consistency (Cronbach's alpha) and ICC values. Thus, the CISS-tv is a suitable tool to use in the clinical and research applications of CI or near visual skill problems in the Thai population. Although the data presents enough evidence to support the efficacy of the CISS-tv comparable to the CISS-ev, it is proposed that future research include relevant clinical data to further confirm the correlation of the CISS-tv score with CI and non-CI groups. As a result of the difficulties in diagnosis of binocular vision problems in Thailand, there is not much evidence or statistics on binocular vision problems among the population in Thailand. Since CISS is now available in Thai, it will increasingly become a powerful tool for many Thai health care providers to access. Therefore, we expect that this CISS in the Thai language version will be able to facilitate more clinicians with the screening, identifying, and monitoring of suspected CI patients in the future.

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Appendix 1 CISS original English version (CISS-ev) and Thai version (CISS-tv)

Item	Original English version	ข้อ	Thai version

1	Do your eyes feel tired when reading or doing close work?	1	คุณรู้สึกตาล้า เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
2	Do your eyes feel uncomfortable when reading or doing close work?	2	คุณรู้สึกไม่สบายตา เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
3	Do you have headaches when reading or doing close work?	3	คุณมีอาการปวดหัว เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
4	Do you feel sleepy when reading or doing close work?	4	คุณรู้สึกง่วงนอน เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
5	Do you lose concentration when reading or doing close work?	5	คุณสูญเสียการจดจ่อ เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
6	Do you have trouble remembering what you have read?	6	คุณมีความยากลำบากในการจดจำสิ่งที่เพิ่งอ่านหรือไม่
7	Do you have double vision when reading or doing close work?	7	คุณเห็นภาพซ้อน เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
8	Do you see the words move, jump, swim or appear to float on the page when reading or doing close work?	8	คุณเห็นตัวอักษรเคลื่อน กระโดด หรือลอยไปมาบนหน้ากระดาษ เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
9	Do you feel like you read slowly?	9	คุณรู้สึกว่าคุณอ่านหนังสือได้ช้าหรือไม่
10	Do your eyes ever hurt when reading or doing close work?	10	คุณเคยเจ็บตา เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
11	Do your eyes ever feel sore when reading or doing close work?	11	คุณเคยรู้สึกปวดตา เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
12	Do you feel a “pulling” feeling around your eyes when reading or doing close work?	12	คุณรู้สึกตึงรอบดวงตา เมื่ออ่านหนังสือหรือทำงานระยะใกล้หรือไม่
13	Do you notice the words blurring or coming in and out of focus when reading or doing close work?	13	คุณเห็นตัวหนังสือเบลอ หรือเดี๋ยวชัดเดี๋ยวไม่ชัดเมื่ออ่านหนังสือ หรือทำงานระยะใกล้หรือไม่
14	Do you lose your place while reading or doing close work?	14	คุณหาตำแหน่งไม่เจอว่าอ่านถึงตรงไหน หรือทำงานระยะใกล้ไปถึงตรงไหนแล้วหรือไม่
15	Do you have to re-read the same line of words when reading?	15	คุณมีการอ่านซ้ำบรรทัดเดิม เมื่ออ่านหนังสือหรือไม่