

# Development of the Hypernasality Modification Program in Thai School-Aged Children with Cleft Lip/Palate

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## Abstract

Hypernasality with/without articulation disorders are significant speech defects among patients with Cleft Lip and/or Palate (CLP), particularly in school-aged children. Thus, there has not been a systematic program to deal with hypernasality for Thais. Therefore, this study aimed to develop a hypernasality modification program for Thai school-aged children with CLP. The hypernasality modification program in Thai school-aged children was practically developed into a systematic manual based on previous literature reviews. The program consisted of multiple steps written from one word to narrative levels, according to Thai syllable structure instruction. After completing the 1<sup>st</sup> version of the development program, content validity was determined by a panel of five experts. The hypernasality modification program showed excellent validity index (S-CVI = 0.98) and item content validity index (I-CVI = 0.8 to 1.0). After the researchers’ panel review and discussion based on the experts’ suggestions, the 2<sup>nd</sup> version was delivered for the next step in the near future. The results indicated that the hypernasality modification program was valid and could be used for Thai school-aged children with CLP. Further research will be needed to determine the effectiveness of this program.

**Keywords:** Hypernasality, Cleft lip/palate, Thai school-aged children

## Introduction

CLP and craniofacial anomalies are birth defects caused by the malformation of the mouth and palate structures. It is the failure of joining each organ to form the appearance of a face and mouth palate between 4–6 weeks to the first trimester of pregnancy (Chantachum, Lekboonyasin, Pradubwong, Pattaranit, & Chowchuen, 2017). In the United States of America, the occurrence

of CLP is approximately 1 in 700 to 1 in 150 newborns (Panamonta, Pradubwong, Panamonta, & Chowchuen, 2015). The prevalence of CLP in Thailand is between 0.58–2.49 in 1,000 newborns and there are approximately 2,000 newborns with CLP throughout Thailand each year (Chantachum et al., 2017; Chowchuen et al., 2015). The cause of CLP is due to congenital factors at 12–20 percent, mothers’ environmental factors,

and other external environmental factors are as high as 80–88 percent (Grewal, Carmichael, Ma, Lammer, & Shaw, 2008; Panamonta et al., 2017). Children with CLP babble differently or are unable to babble like typical children. As they get older, they commonly have Compensatory Articulation Disorders (CADs), such as velar substitution, glottal and / or pharyngeal substitution, nasal substitution, and mid-dorsum palatal substitution, which are commonly found at 23–67 percent (Prathanee, Seepuham, & Pumnum, 2014b; Prathanee, Thanawirattananit, & Thanaviratananich, 2013b). These are caused by the inability of the soft palate to make contact with the posterior pharyngeal wall to close the gap to the nose cavity during speech, and is known as velopharyngeal insufficiency (VPI), if VPI is not treated early, it can result in resonance disorders (20–25 percent) after palatoplasty (Prathanee, Pumnum, & Seepuham, 2013a). The big problem affecting children with CLP speech is hypernasality, which is found in approximately 50 percent of CLP children (Prathanee et al., 2013a; Prathanee et al., 2014b). Depending on the problem and needs of each child, they may need surgery, a speech device, or speech therapy with a Speech and Language Pathologist (SLP) (Peterson-Falzone, Hardin-Jones, & Karnell, 2010; Prathanee et al., 2014b).

There are common and accepted speech therapy tools and techniques to address VPI, such as stethoscope, listening tube, or see-scape (Kummer, 2014). Most SLPs prefer to use compensatory articulation therapy, such as phonological correction therapy, to help children with CLP pronounce sounds correctly and which may reduce hypernasality. A study found that after speech therapy with phonological correction therapy, children with CLP showed significant reductions in various articulation substitutions (Pamplona, Ysunza, & Espinosa, 1999; Prathanee et al., 2014a). In other words, if there are more effective techniques and/or programs to reduce hypernasality to use in addition to phonological correction therapy, which aims to reduce or fix articulation substitution, for example, velar substitution or

phoneme-specific nasal air emission, children with CLP will have both reduced articulation substitution and hypernasality. They will also have improved expressive communication skills, allowing others to better understand their speech (Peterson-Falzone et al., 2010; Scherer, D'Antonio, & McGahey, 2008). The researchers realized the importance of a training program to reduce hypernasality and searched for an effective hypernasality program related to phoneme. Based on literature reviews, the 'hypernasality modification program' is a tool that is effective in reducing hypernasality (Ray & Baker, 1990). It is a program for decreasing hypernasality, related to English phonology. Therefore, the researchers chose to develop "The hypernasality modification program for Thai school-aged children" based on the conceptual framework and theory of the hypernasality modification program related to Thai phonology, to reduce hypernasality.

## Objectives

The purpose of this study was to test the content validity of the hypernasality modification program in Thai school-aged children with CLP.

## Methods

This study was certified by the Khon Kaen University Ethics Committee in Human Research. The project number is HE611442. The process of developing the hypernasality modification program in Thai school-aged children with CLP had 3 steps as follows:

### 1. Development of the hypernasality modification program in Thai school-aged children with CLP

Firstly, literature review and development of the hypernasality modification program in Thai school-aged children with CLP followed the conceptual framework and manual of the hypernasality modification program (Ray & Baker, 1990). This program is divided into 2 parts: 1) Assessment (Prathanee, Lorwatanapongsa, Anantapong, & Buakanok, 2011) and 2) Training,

following the hypernasality modification program in Thai school-aged children with CLP, divided into 2 parts: 1) training instructions and 2) list levels ranging from words to narratives. Training instructions include training objectives in each context and/or level, details of each context and/or level, training criteria and methods. These training instructions were based on the conceptual framework from the hypernasality modification program manual. Traditional strategies for reduction of hypernasality would be used with this program for helping children to get rid of hypernasality. For example, the investigator could repeat the same context/level of training or choose strategies to reduce hypernasality, such as widening the mouth during speech, gentle touching of speech organs during speech, and reducing speech speed (Peterson-Falzone et al., 2010).

List levels, ranging from words to narratives, were divided into a word, words and/or phrases with 2-3 syllables, sentences and narrative levels. Researchers designed the training explanations in each list, and created the lists from word level, words and/or phrases with 2-3 syllables, sentence level and narrative level, by adjusting the English contents to match Thai phonology. The list includes words, words and/or phrases with 2-3 syllables, and sentences containing at least 10 words, words and/or phrases with 2-3 syllables, and sentences for each context. In each training narrative level, researchers composed 30 stories with all initial and final Thai consonants. There is a total of 29 contexts divided into 4 levels of words with 1 'syllable' level (contexts 1-14), words and/or phrases with 2-3 syllables level (contexts 15-22), sentence level (contexts 23-28), and narrative level (context 29). The lists of contents were individually reviewed and consensus was made for clarification and appropriate content by the researchers.

## 2. Determination of content validity

The 1<sup>st</sup> draft of the hypernasality modification program in Thai school-aged children with CLP, was tested for content validity

via a panel of 5 experts. The criteria for expert qualification of 4 senior SLPs was at least an education degree, a masters degree of communication sciences and disorders, and who had at least 5 years experience in treating clients with CLP, and 1 linguist whose education included more than 5 years experience in Thai phonetics or linguistics fieldwork. The experts assessed the program and suggested correction of the contents for each item. Calculation of the content validity index for individual items and an overall scale were done. After the researchers' panel review and discussion, based on the experts' suggestions, the 2<sup>nd</sup> draft of the hypernasality modification program in Thai school-aged children with CLP was completed. It was also prepared for the next step of testing the validity and effectiveness of this program for the final version. The content validity of individual items was calculated using the formula:  $I-CVI = a/n_{jude}$ , where I-CVI = content validity index of individual items, a = number of experts who scored relevant on the item content (gave a 3 and 4 level), and  $n_{jude}$  = total number of experts. Content validity for overall scale was calculated using the formula:  $S-CVI = \sum I-CVI/p$ , where S-CVI = content validity index for overall scale,  $\sum I-CVI$  = sum of I-ICVI, and p = number of individual items

## 3. Criteria of data analysis

Data analysis for testing content validity, via a panel of 5 experts, was done by calculating the item content validity index (I-CVI) which was the decision of the 5 experts on whether the individual items were relevant, by giving a 3 or 4 score. The formula for I-CVI = number of experts who thought the item was valid, divided by the total number of experts. The I-CVI should be equal to 1. The content validity for overall scale (S-CVI) formula is  $S-CVI = \sum I-CVI/p$ , which is calculated by the sum of all I-CVI divided by the total number of items. The S-CVI should be at 0.8 or above.

## Results

Each item content validity index (I-CVI) of the hypernasality modification program in Thai school-aged children with CLP, was between

0.8-1 from the total content of 70 items, as shown in Table 1. The 5 experts mostly gave a score of 3 (somewhat relevant) and 4 (very relevant). The content validity index for overall scale was 0.98.

**Table 1:** Item content validity of the hypernasality modification program in Thai school-aged children with CLP

Assessment list	Expert's opinions					Item-CVI
	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	
<b>Instructional aspect</b>						
1. Instructions are complete and sufficient	3	4	3	3	3	5/5=1
2. Practices in the hypernasality modification program in school aged children with CLP are understandable and clear	3	3	3	3	4	5/5=1
<b>Content aspect</b>						
<b><i>Voiceless consonant+Vowels group+Voiceless consonant</i></b>						
<i>Voiceless consonant with plosive sounds+vowels+voiceless consonant with plosive sounds</i>	3	3	4	4	4	5/5=1
3. Illustrations are related to the words written as determined in the format						
4. Words written matched the determined format	2	4	4	3	3	4/5=0.8
<i>Voiceless consonant with affricate sounds+vowels+voiceless consonant with plosive sounds</i>	3	3	4	4	4	5/5=1
5. Illustrations are related to the words written as determined in the format						
6. Words written matched the determined format	2	4	4	3	4	4/5=0.8
<i>Voiceless consonant with fricative sounds+vowels+voiceless consonant with plosive sounds</i>	3	4	4	4	3	5/5=1
7. Illustrations are related to the words written as determined in the format						
8. Words written matched the determined format	2	4	4	3	4	4/5=0.8
<b><i>Voiceless Consonants+Vowels Group</i></b>						
<i>Voiceless consonant with plosive sounds+vowels</i>						
9. Illustrations are related to the words written as determined in the format	3	4	4	4	3	5/5=1
10. Words written matched the determined format	3	4	4	3	4	5/5=1
<i>Voiceless consonant with affricate sounds+vowels</i>						
11. Illustrations are related to the words written as determined in the format	3	4	4	4	3	5/5=1
12. Words written matched the determined format	3	4	4	3	4	5/5=1
<i>Voiceless consonant with fricative sounds</i>						
13. Illustrations are related to the words written as determined in the format	3	3	4	4	3	5/5=1
<b><i>Voiced Consonant+Vowels Group+Voiceless Consonant</i></b>						
<i>Voiced consonant with plosive sounds+vowels+voiceless consonant with plosive sounds</i>	3	3	4	4	4	5/5=1
15. Illustrations are related to the words written as determined in the format						
16. Words written matched the determined format	2	4	4	3	4	4/5=0.8

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	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	
<i>Voiced consonant with open/trill sounds+vowels+voiceless consonant with plosive sounds</i> 17. Illustrations are related to the words written as determined in the format	3	4	4	4	4	5/5=1
18. Words written matched the determined format	3	4	4	3	4	5/5=1
<b><i>Voiceless Consonant+Vowels Group+Voiced Consonant</i></b>						
<i>Voiceless consonant with plosive sounds+vowels+voiced consonant with open sounds</i> 19. Illustrations are related to the words written as determined in the format	3	4	3	4	4	5/5=1
20. Words written matched the determined format	3	4	3	3	4	5/5=1
<i>Voiceless consonant with affricate sounds+vowels+voiced consonant with open sounds</i> 21. Illustrations are related to the words written as determined in the format	3	4	4	3	3	5/5=1
22. Words written matched the determined format	3	4	3	3	4	5/5=1
<i>Voiceless consonant with fricative sounds+vowels+ voiced consonant with open sounds</i> 23. Illustrations are related to the words written as determined in the format	3	3	3	3	3	5/5=1
24. Words written matched the determined format	3	4	3	4	4	5/5=1
<b><i>Voiced Consonant+Vowels Group</i></b>						
<i>Voiced consonant with plosive sounds+long vowels</i> 25. Illustrations are related to the words written as determined in the format	3	4	3	4	3	5/5=1
26. Words written matched the determined format	3	4	4	3	4	5/5=1
<i>Voiced consonant with open/trill sounds+long vowels</i> 27. Illustrations are related to the words written as determined in the format	3	4	3	4	4	5/5=1
28. Words written matched the determined format	3	4	4	3	4	5/5=1
<b><i>Voiced Consonant+Vowels Group+Voiced Consonant</i></b>						
<i>Voiced consonant with plosive sounds+vowels+voiced consonant with open sounds</i> 29. Illustrations are related to the words written as determined in the format	3	4	3	4	4	5/5=1
30. Words written matched the determined format	3	4	3	3	4	5/5=1
<i>Voiced consonant with open/trill sounds+vowels+ voiced consonant with open sounds</i> 31. Illustrations are related to the words written as determined in the format	3	4	3	4	4	5/5=1
32. Words written matched the determined format	3	4	3	3	4	5/5=1
<i>Single Vowel Group</i> 33. Illustrations are related to the words written as determined in the format	4	4	3	3	3	5/5=1
<i>Consonant with nasal sounds+vowels group+voiceless consonant</i> 34. Illustrations are related to the words written as determined in the format	3	4	4	4	4	5/5=1
35. Words written matched the determined format	2	4	4	4	4	4/5=0.8

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Assessment list	Expert's opinions					Item-CVI
	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	
<i>Consonant with nasal sounds+vowels group</i>						
36. Illustrations are related to the words written as determined in the format	3	4	4	4	3	5/5=1
37. Words written matched the determined format	3	4	4	3	4	5/5=1
<i>Consonant with nasal sounds+vowels group+voiced consonant</i>						
38. Illustrations are related to the words written as determined in the format	3	2	4	4	3	4/5=0.8
39. Words written matched the determined format	3	4	3	4	3	5/5=1
<b><i>Voiceless Consonant+Vowels Group+Consonant with Nasal Sounds</i></b>						
<i>Voiceless consonant with plosive sounds+vowels+consonant with nasal sounds</i>						
40. Illustrations are related to the words written as determined in the format	3	4	4	4	3	5/5=1
41. Words written matched the determined format	3	4	4	4	4	5/5=1
<i>Voiceless consonant with affricate sounds+vowels+consonant with nasal sounds</i>						
42. Illustrations are related to the words written as determined in the format	3	4	3	4	3	5/5=1
43. Words written matched the determined format	3	4	4	4	4	5/5=1
<i>Voiceless consonant with fricative sounds+vowels+ consonant with nasal sounds</i>						
44. Illustrations are related to the words written as determined in the format	3	4	4	4	3	5/5=1
45. Words written matched the determined format	3	4	4	4	4	5/5=1
<b><i>Voiced Consonant+Vowels Group+Consonant with Nasal Sounds</i></b>						
<i>Voiced consonant with plosive sounds+vowels+consonant with nasal sounds</i>						
46. Illustrations are related to the words written as determined in the format	4	3	4	4	3	5/5=1
47. Words written matched the determined format	4	4	4	4	4	5/5=1
<i>Voiced consonant with open/trill sounds+vowels+consonant with nasal sounds</i>						
48. Illustrations are related to the words written as determined in the format	3	4	4	3	4	5/5=1
49. Words written matched the determined format	3	4	4	4	4	5/5=1
<i>Consonant with nasal sounds+vowels group+ consonant with nasal sounds</i>						
50. Illustrations are related to the words written as determined in the format	3	4	4	4	4	5/5=1
51. Words written matched the determined format	3	4	4	4	4	5/5=1
<i>Answering question activity at 1 syllable level</i>						
52. Each question is clear and understandable	3	4	4	4	3	5/5=1
<i>Words and phrases with 2-3 syllables, voiceless consonant</i>						
54. Words and phrases with 2-3 syllables written matched the determined format	3	4	4	4	4	5/5=1
<i>Words and phrases with 2-3 syllables, voiceless consonant and voiced consonant</i>						
55. Words and phrases with 2-3 syllables written matched the determined format	4	4	3	4	4	5/5=1

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Assessment list	Expert's opinions					Item-CVI
	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	
<i>Words and phrases with 2-3 syllables, voiced consonant</i> 56. Words and phrases with 2-3 syllables written matched the determined format	4	4	3	4	4	5/5=1
<i>Words and phrases with 2-3 syllables, which have initial consonants with nasal sounds</i> 57. Words and phrases with 2-3 syllables written matched the determined format	3	4	3	4	4	5/5=1
<i>Words and phrases with 2-3 syllables, which contain consonants with nasal sounds in the middle</i> 58. Words and phrases with 2-3 syllables written matched the determined format	3	4	3	4	3	5/5=1
<i>Words and phrases with 2-3 syllables, which contain consonants with nasal sounds at the end</i> 59. Words and phrases with 2-3 syllables written matched the determined format	3	4	3	4	3	5/5=1
<i>Words and phrases with 2-3 syllables, with multiple syllables containing consonants with nasal sounds</i> 60. Words and phrases with 2-3 syllables written matched the determined format	3	4	3	4	3	5/5=1
<i>Answering question activity with words and phrases from 2-3 syllables level</i> 61. Each question is clear and understandable	3	3	4	4	4	5/5=1
62. Questions can be answered in words and phrases with 2-3 syllables	3	4	3	4	4	5/5=1
<i>Sentences with voiceless consonant</i> 63. Sentences written matched the determined format	4	4	3	4	4	5/5=1
<i>Sentences with voiceless and voiced consonants</i> 64. Sentences written matched the determined format	3	4	3	4	4	5/5=1
<i>Sentences with voiced consonants</i> 65. Sentences written matched the determined format	4	4	4	4	4	5/5=1
<i>Sentences with 1 syllable nasal consonant</i> 66. Sentences written matched the determined format	3	4	3	4	4	5/5=1
<i>Words and phrases with 2-3 syllables, with multiple syllables containing consonants with nasal sounds</i> 67. Words and phrases with 2-3 syllables written matched the determined format	3	4	3	4	3	5/5=1
<i>Sentences with multiple syllables containing nasal consonants</i> 68. Sentences written matched the determined format	3	4	3	4	4	5/5=1
<i>Answering question activity at sentence level</i> 69. Each question is clear and understandable	3	4	3	4	4	5/5=1
70. Questions can be answered in sentences	3	4	4	4	4	5/5=1
<i>Narrative level</i> 71. Stories for each consonant are easy to read and understandable	3	4	4	4	4	5/5=1



## Discussion

Design and creation of the 4 lists following the theoretical framework of the original hypernasality modification program, resulted in the development of a hypernasality modification program for Thai school-aged children with CLP, which can be adjusted for VPI. However, the hypernasality modification program in Thai school-aged children with CLP needs to be trialled and/or tested for program effectiveness in reducing hypernasality in school-aged children with CLP. Minor adjustments can be made to explanations to make the language easier to read, shorter, and more clearly understood. As for the design of the 4 lists for application during the hypernasality modification program in Thai school-aged children with CLP, some list levels may need adjustments to the words, phrases or sentences to make the language appropriate for school-aged children to read aloud on their own and/or understand what they have read, for example, words which are transliterated from foreign languages, such as the English words 'fit' or 'surge'. Experts suggested avoiding unfamiliar transliterate words from foreign languages, as children may not understand the meaning of the words (Kuehn & Moller, 2000). Moreover, pictures can be added to make it simpler for children to understand, to attract their attention, and increase cooperation with SLPs. The training explanations in each list received coherent feedback from the experts, namely, that they should be written in clear steps in the hypernasality modification program for Thai school-aged children with CLP, so that SLPs who may not have experience with CLP children, can apply this program correctly and appropriately. As for the lists, experts commented that there may be a need to adjust some words, phrases and sentences to match Thai school-aged children because reading ability varies in children of different ages. Another option is to add a step training instruction to each list stating that children can read aloud on their own and/or repeat to the SLP. In previous studies (Andrews, Tardy, & Pasternak, 1984), the hypernasality

modification program was developed into a theoretical framework which considered the child's age, intellectual ability, and language development. It is divided into 4 stages with stages 1-3 focusing on training children to learn sounds coming through the nose and mouth to reduce hypernasality, while stage 4 focuses on the training of speaking and listening to also reduce hypernasality. Building children's self-awareness is related to the theoretical framework and concepts of the development of the hypernasality modification program in Thai school-aged children with CLP.

## Strengths and Limitations

The hypernasality modification program in Thai school-aged children with CLP is a systematic program in Thailand. It was tested and had an excellent content validity index. It has not been tested for reliability, therefore, future research should be conducted to test the effectiveness of the hypernasality modification program in Thai school-aged children with CLP.

## Conclusion

Development of the hypernasality modification program in Thai school-aged children with CLP can be adjusted for VPI. SLPs should thoroughly study the hypernasality modification program for Thai school-aged children with CLP before using this program. However, future research should test the reliability and effectiveness of the hypernasality modification program in Thai school-aged children with CLP and also be extended to other groups of disorders with hypernasality.

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