

Original article

Cross-cultural adaptation and reliability of the water orientation test Alyn into Thai version: Preliminary study

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Abstract

Background: Hydrotherapy benefits children with developmental disorders who find land-based physical activity challenging. Water Orientation Test Alyn (WOTA1 and WOTA2) offers reliable and cost-effective means to any group with or without disabilities and at all ages, starting at 4 - 5 years.

Objectives: This study aimed to translate and adapt the WOTA into Thai and evaluate their internal consistency and interrater reliability in Thai children and youths.

Methods: WOTA1 and WOTA2 were translated through a forward-backward translation process and reviewed by experts. Cronbach's alpha, percent agreement, and intraclass correlation coefficients (ICCs; 95% CI) were used to calculate internal consistency, inter-rater agreement, and inter-rater reliability, respectively. Weighted kappa coefficients (K_w) were applied in item-level analyses to measure the degree of agreement between raters on a 4-ordinal scale. Assessors evaluated children's performance in a swimming pool setting (30 minutes/child).

Results: The cross-cultural translation process achieved consensus and equivalence, ensuring understandable terminology and command language. Phase II assessed Thai-WOTA1 and Thai-WOTA2 separately. Percent agreement between raters indicated excellent agreement (90.9% for Thai-WOTA1; 100.0% for Thai-WOTA2). Cronbach's alpha was > 0.9 in both instruments, suggesting excellent internal consistency of the Thai-WOTA. ICC of 0.92 (95% CI = 0.87 - 0.96) for Thai-WOTA1 and of 0.96 (95% CI = 0.91 - 0.99) for Thai-WOTA2, suggesting excellent interrater reliability. Weighted kappa of test items in both Thai-WOTA1 and Thai-WOTA2 indicated excellent agreement ($K = 0.7$ to 1.00).

Conclusion: The preliminary study conducted in Thailand demonstrates excellent reliability in the Thai-WOTA1 and Thai-WOTA2 assessments among the Thai children's population, indicating potential for future research.

Keywords: Cross-cultural adaptation, hydrotherapy, internal consistency, inter-rater reliability, WOTA assessment.

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Aquatic therapy is a meaningful and practical therapeutic exercise for children with motor difficulties and special needs, particularly those with cerebral palsy (CP).⁽¹⁻⁵⁾ It utilizes water's hydrodynamic properties like buoyancy, hydrostatic pressure, and viscosity (a resistance to flow) to improve children's function. The benefits of aquatic therapy can yield physiological effects such as reduced gravitational impact due to water's buoyancy, enhanced muscle relaxation, and improved gross motor function. Hydrostatic pressure assists in reducing swelling and enhancing blood circulation, while the therapeutic utilization of the water resistance can strengthen muscles and improve cardiovascular fitness.^(5, 6) Developmental disorders refer to a broad categories of syndromes in which normal developmental sequences or patterns are disturbed, resulting in deviations from or delays in developmental milestones. Genetic, environmental, or emotional factors may cause these abnormalities in the child's developmental processes.⁽⁷⁾ Some examples of developmental disorders are cerebral palsy, Down's syndrome, spina bifida, and spinal muscular atrophy. Cerebral palsy (CP) is the most prevalent cause of physical disability in childhood.^(7,8) The complex of signs, the disorder's severity, the patterns of motor involvement, and the associated impairments such as those of communication, cognitive ability, and epilepsy vary broadly.⁽⁹⁾ Children with CP and other developmental disorders put a strong demand on services, treatment, and technical adaptations.^(8, 9)

The international classification of functioning disability and health, children and youth (ICF-CY, WHO 2007)⁽¹⁰⁾, addresses the significance of 'active participation' as a vital therapeutic outcome. Aquatic therapy for children with motor disabilities involves actively engaging them within the water environment. For example, the Halliwick concept,⁽¹¹⁾ operationalized within its ten-point program, designates subjects as 'swimmers,' highlighting their active involvement rather than a passive reception of therapy.^(11, 12) Its goals include enhancing independence in water, improving the body's rotational movement and balance, strength, and endurance, ultimately aiming to teach basic swimming techniques to children.^(11, 12) Therefore, clinical practices in paediatric aquatic therapy play a pivotal role, enabling children not only to benefit therapeutically but also to enjoy leisure activities.⁽¹¹⁻¹³⁾ Numerous Thai children with motor difficulties and special needs could significantly

profit from broader availability of aquatic therapy programs. Nonetheless, the establishment of a paediatric aquatic program in Thailand has been insufficient. Furthermore, the existing assessment tools commonly stem from English-speaking countries, and there is currently a lack of outcome measures for the field of paediatric hydrotherapy available in the Thai language. This is crucial because children with special needs, such as cerebral palsy, frequently display subtle changes in the progression of movement control in water. Using an evaluation tool based on a specific therapeutic approach allows for accurate measurement, evaluation, goal setting, and the recognition of a child's progression, all while maintaining consistent terminology aligned with the intervention.⁽¹⁴⁾

The water orientation tests Alyn (WOTA1 and WOTA2)⁽¹⁴⁾ were developed to assess the mental adjustments and water functional abilities in any group with or without disabilities and at all ages, starting at 4-5 years (WOTA English guideline, non-published material).⁽¹⁴⁾ Many of those swimmers are children and adults with neurological conditions who receive hydrotherapy or aquatic therapeutic program. The WOTA test-items based on the ten-point program of the Halliwick concept, therefore, each item corresponds to one of the ten steps in the Halliwick concept (IHA 2010).^(11, 12, 14) The validity and reliability of the WOTA1 &-2 were confirmed (test-retest reliability: WOTA1 ICC = 0.97, WOTA2 ICC = 0.97, reliability of test-item score: fair to good, weight $K > 4$), demonstrating their suitability as effective instruments for monitoring changes over time. As for the validity, a positive moderately significant association was found between the WOTA total score and motor performance on land (the Brief assessment of motor function test (BAMF) and WOTA1 score, $r_p = 0.56$, $P < 0.05$; and the Gross motor function measure (GMFM) and WOTA2 function subtest score, $r_p = 0.6$, $P < 0.05$).⁽¹⁴⁾ The WOTA1 mainly evaluates children with a difficulty to follow simple instructions on their (1) general mental adjustment, and (2) ability to control breathing above and underwater. The WOTA2 assesses (1) how well an individual adapts psychologically to the water environment, and (2) his/her specific functioning in water, referred to as "The Skills." Thus, the WOTA2 targets children who can more readily follow instructions.⁽¹⁴⁾ Four studies have addressed the reliability and validity of the WOTA assessments: the English original version⁽¹⁴⁾,

the Portuguese version⁽¹⁵⁾, Brazilian version⁽¹⁶⁾, and the Chinese version which only tested the WOTA1 form.⁽¹⁷⁾ Other studies applied the WOTA for the assessment of aquatic skills as one of their studies' outcome measures to evaluate the benefit of Halliwick-based therapy, aquatic exercise, or aquatic interventions in children with cerebral palsy⁽¹⁸⁾, neuromuscular disorders⁽¹⁹⁾, and autistic spectrum disorder.⁽²⁰⁾

Therefore, this study aimed to investigate: 1) the translation and cross-cultural adaptation of the WOTA1 and WOTA2 assessment to Thai; and 2) the interrater reliability and internal consistency reliability of the Thai-WOTA1 and Thai-WOTA2 in Thai children with disabilities.

Materials and methods

The Thai-WOTA project was conducted in two phases. Phase I was the linguistic translation and cross-cultural adaptation of the Thai-WOTA1 and Thai-WOTA2. Phase II the psychometric properties of the Thai-WOTA1 was performed first, then the following year the Thai-WOTA2 was assessed. All processes were performed in accordance with the Declaration of Helsinki. Permission for translation and cross-cultural adaptation of the WOTA1 and WOTA2 was obtained from Alyn.org, Children Hospital, Israel, via e-mail.

Phase 1: Cross-cultural translation

For the cross-cultural adaptation, we followed the recommendations published by Beaton DE, *et al.*⁽²¹⁾ Upon receiving a permission, we obtained the original test-forms and the 3rd edition of the English guideline which clarifies the test-items and offers criteria for scoring the WOTA assessment. MB was trained by Tirosh R. the Head of Hydrotherapy Department, a Jerusalem-based Paediatric and Adolescent Rehabilitation Center, Alyn Hospital, Israel. Forward translation (FWT) was carried out separately by FWT1 and FWT2 by two Thai paediatric physical therapists (NT and MB) who have combined clinical and research experience of more than 25 years. Both NT and MB had experience in the field of paediatric hydrotherapy. MB, PA, and three research assistants (bachelor students in physical therapy) debated and combined the two versions to create the final Thai version that practically used in a hydrotherapy session. Two back-translations into English (BT1 and BT2) were subsequently completed separately by PT and

KN, a Ph.D. linguistics lecturer in English and a professional translator, without being aware of the original WOTA assessments. Next, MB, PA, and two research assistants (bachelor students in physical therapy) synthesized and combined the BT1 and BT2 into a final back-translated version. MB was the master trainer of the WOTA-1&2 instructions and manual to PA, four raters, and five research assistants.

Lastly, a review committee monitored the process and approved the pre-final Thai-WOTA version. The expert committee consisted of Tirosh R. (the original developer of WOTA)⁽¹⁴⁾, MB (the project leader and forward translator), PT (the backward translator), and one independent member (PA, with 15 years of expertise in paediatric physiotherapy). Tirosh R. offered feedback on the semantic, idiomatic, experiential, and conceptual equivalences for the final back-translated version compared to the original WOTA forms. The Thai committee (MB, PT, and PA) consolidated all the translations and reached a consensus on any discrepancy. Five healthy children (age between 4 - 12 years old) who were left out of the data analysis were evaluated on these pre-final Thai-WOTA1 and 2 forms for clarity of the instructions and comprehensiveness of the test-items, and culturally suitable phrasing. The Thai-WOTA1 and Thai-WOTA2 were used as outcome measures for preliminary psychometric testing consequently. MB directed a comprehensive training session for four aquatic therapists who took part in a reliability assessment (Thai-WOTA1: TK and JK; Thai-WOTA2: ChJ and KK).

Phase 2. Evaluation: Internal consistency and interrater reliability

Study design

The first part of this multi-site, cross-sectional preliminary study focused on the WOTA-1 evaluation, and the second part on the WOTA2. Between November 2020 and December 2021, purposeful sampling was used to recruit subjects in Thailand's northern regions' hospitals, rehabilitation facilities, and public schools. The Medical Ethics Committee of Naresuan University, located in Phitsanuloke Province, reviewed the study (COA no. 263/2020; IRB no. P3-0022/2563). This study complies with the general data protection regulation (GDPR). Written informed consent was obtained from the child's parents/caregivers and youths, following the guidelines of the Medical Ethics Committee.

Subjects

Part one: To achieve the power of 0.9 with alpha 0.05 for assessing internal consistency and inter-rater reliability, the minimum sample size needed⁽²²⁾ were 12 children for the 13 items of WOTA1, and 7 children for the 27 items of WOTA2, with a 4-point ordinal scale for each test-item. The Bonett DG's formula was a basis for this calculation.⁽²³⁾ The characteristics of subjects are listed in **Table 1**. In the beginning, the Thai-WOTA1 was evaluated in November 2020. We were able to recruit a total of 22 children with developmental disabilities (median age = 8 years; age range from 4 - 16 years, 11 females and 11 males) from Rajanagarindra institute of child development (RICD), Chiang Mai, Thailand. Inclusion criteria were as follows: 1) diagnosis of cerebral palsy (bilateral spastic, unilateral spastic, or dyskinetic) or motor developmental disorder other than CP; 2) age of 4 to 18 years; 3) all level of motor severity; and 4) ability to follow instructions. Exclusion criteria were as follows: 1) poorly controlled epilepsy; 2) severe auditory or visual problems; and 3) skin problems such as open wounds or active infection.

Thai-WOTA1 raters were JK and TK, both have more than 8 years of experience in pediatric aquatic therapy at the RICD Center, Chiang Mai, Thailand.

Part Two: The Thai-WOTA2 was administered in 2021. We were only able to recruit 13 children and youths with typical developing, age between 4 and 14 years old (median age = 9 years 5 months) from local schools in Phitsanuloke Province. Our Thai-WOTA2 sample size consisted of 6 females and 7 males. Thai-WOTA2 raters were CH-J and KK, who have 3 years of experience in aquatic therapy at the Hydrotherapy Rehabilitation Center, Naresuan University, Phitsanuloke Province.

Our preliminary study had two different types of subjects as we conducted our study during the COVID-19 pandemic in Thailand, which had an impact on the few hours that clinical services were open as well as a small number of children who were eligible for the study.⁽²⁴⁾ Besides, there are hardly any children with disabilities in Thailand who can perform advanced aquatic activities according to the WOTA2 assessment. However, according to power calculation^(22,23), our sample size for this preliminary study was feasible.

Measures

Water orientation test alyn (abbrev. WOTA1 and WOTA2)

Part one, WOTA1 (13 items;), mainly evaluates a child's mental adjustment and a basic function in the water with a supportive level of an assessor. This evaluation is designed for swimmers with limited functional and cognitive abilities, children of all ages, who have difficulty to follow simple instructions. Also, the test can be used in children with typical developing up to 4 years, based on their previous swimming experience.⁽¹⁴⁾

Part two, the WOTA2 (27 items), addresses the child's more complex functions and breathing control in the water. Children and adolescents who can follow verbal instructions and commands are well-suited for the test. It consists of four sections: mental adjustment (1 item), breathing control (5 items), balance and mobility (17 items), and basic swimming skills (4 items).⁽¹⁴⁾

An assessor scores each item using a 4-point ordinal scale, ranging from 1 to 4 scores for WOTA1 and 0 to 3 scores for WOTA2. For general mental adjustment and breathing control, 0 indicated does not perform, 1 = poor quality, 2 = moderate quality, and 3 = high quality. For balance and function control, 0 indicated does not perform, 1 = perform with full support, 2 = partial support, and 3 = independently perform.⁽¹⁴⁾

Gross motor function classification system (GMFCS)

In addition, the gross motor function classification system (GMFCS)⁽²⁵⁾ was used to classify severity of subjects with CP, the main group of this study. The GMFCS uses a five-level system (I - V) that describes the gross motor function of children and youth with CP and corresponds to the extent of ability limitation, with level V indicating the highest degree of motor limitation.⁽²⁵⁾

Evaluation

Assessments were carried out in a kid-friendly swimming pool environment. A child's performance was graded independently by each rater. The rater not only provided verbal instructions but also demonstrated a necessary task. The best performance of each item was evaluated after the child had performed it three times. Based on the child's achievement and independence, each ability was rated

Table 1. Characteristics of study sample: Part 1 (Thai WOTA1); Part 2 (Thai WOTA2).

Part 1: Thai WOTA1, children with disability (n = 22).	
Age [years; median (min - max) ^a]	8 (4 - 16)
Gender	
Male : female	11 : 11
Disability of a group with special needs	
Bilateral spastic CP	15 (68.2)
Unilateral spastic CP	1 (4.6)
Dyskinetic CP	3 (13.6)
Trisomy 21	1 (4.6)
Spina bifida	1 (4.6)
Spinal muscle atrophy	1 (4.6)
GMFCS level I, II, III, IV, V	1, 0, 9, 11, 1
(number of children)	
Duration of aquatic therapy	All 22 children attended
Count for months [median (min - max) ^a]	9 months (4 - 30)
Total WOTA1 scores	[Maximum 52 scores]
median scores of 22 children	(median (min - max) ^a)
Rater 1	37 scores (16 - 52)
Rater	36.5 scores (14 - 52)
Part 2: Thai WOTA2, children with typical developing (n = 13).	
Age [years; median (min - max) ^a]	9.5 (4 - 14)
Gender	
Male : female	7 : 6
Duration of swimming lessons	
Attended time [median (min - max) ^a]	20 months (6 - 60) (9 children)
No experience	4 children
Total WOTA2 scores	(Maximum 81 scores)
median scores of 13 healthy children	[median (min - max) ^a]
Rater 3	67 scores (16 - 81)
Rater 4	67 scores (14 - 81)

^aMedian value and range (minimum to maximum); Rater 1, TK; rater 2, JK; rater 3, Ch-J; rater 4, KK.

on a 4-point scale (1 to 4 for Thai-WOTA1, and 0 to 3 for Thai-WOTA2). As for Thai-WOTA1 and Thai-WOTA2, the maximum score was 52 and 81 points, respectively. ⁽¹⁴⁾ Research assistant team (five bachelor students: three students assisted in the Thai-WOTA1 and two in the Thai-WOTA2) promptly collected the score sheets. Thus, the Thai-WOTA raters were all blinded from compiling scores, while the research assistant team were all blinded from the evaluations in a swimming pool. The research assistant team summarized the score sheets and informed the data to a statistician expert (OK).

Statistical analysis

The clinical statistics, including the WOTA assessment scores of a child were analysed with

descriptive statistics (median value and range (minimum - maximum). Cronbach's alpha was used to evaluate the internal consistency of the Thai-WOTA1 and Thai-WOTA2 total scores (values of 0.7 or higher indicate acceptable internal consistency). The percent agreement of the total scores between each rater-pairs was used to determine inter-rater agreement (Part One [WOTA1] in children with disabilities: Rater TK and rater JK, and Part Two [WOTA2] in children with typical developing: Rater CH-J and rater KK). Intraclass correlation coefficients (ICCs) and 95% confidence intervals (95% CI) were used to calculate interrater reliability. For item-level analyses, weighted kappa coefficients (K_w) were applied in item-level analyses to measure the degree of agreement between each rater-pairs

on a 4-ordinal scale: 1 to 4 scores of the 13 test items for WOTA1, and 0 to 3 scores of the 27 test items for WOTA2. K levels more than 0.75 are excellent, and values between 0.40 and 0.75 are considered fair to good (Fleiss JL, *et al.*). For statistical analysis, SPSS 26.0 was used. Alpha was set at 0.05 for statistical significance. ^(23, 26 - 28)

Results

In Phase I: *Cross-cultural translation*

After four rounds of the cross-cultural translation process, consensus, and equivalence for both cultures were attained. These outcomes validated the translation and cultural adaptation, i.e., the terminology was understandable, and the command language was unambiguous.

In Phase II: *Evaluation: Internal consistency and interrater reliability*,

In Part One: Thai-water orientation test Alyn 1 (Thai WOTA1), two Thai raters and 22 children with disabilities from RICD Center, Chiang Mai, Thailand completed the study. In Part Two: Thai WOTA2, two Thai raters at the Hydrotherapy Rehabilitation Center, Naresuan University and 13 children with typical developing from local schools in Phitsanuloke Province, Thailand completed the study. The clinical characteristics, the distribution across GMFCS levels for children with CP, and the duration that children

attended aquatic therapy including the Thai-WOTA scores were presented in **Table 1**. This study aimed to examine the internal consistency and interrater reliability of the Thai-WOTA1 in children with disabilities and the Thai-WOTA2 in children with typical developing. Percent agreement between rater-pairs indicated excellent agreement at 90.9% for Thai-WOTA1 and at 100.0% for Thai-WOTA2 (**Table 2**). Cronbach's alpha was > 0.9 , suggesting that the internal consistency of Thai-WOTA instruments was excellent. ICC of 0.92 [95% confidence interval (CI) = 0.87 - 0.96] for Thai-WOTA1 and of 0.96 (95% CI = 0.91 - 0.99) for Thai-WOTA2 suggested excellent interrater reliability among each rater-pair (**Table 2**).

Table 3 presents the item-level analysis (interrater agreement, kappa values). Weighted kappa values of test items in both Thai-WOTA1 and Thai-WOTA2 pointed towards substantial to almost perfect agreement ($K = 0.7$ to 1.0). An exception was on item 7 in Thai-WOTA1 ($K = 0.5$) and item 2 in Thai-WOTA2 ($K = 0.4$), which indicated moderate agreement.

Discussion

This preliminary study satisfactorily completed the translation and cross-cultural adaptation of the water orientation test alyn (WOTA1 and WOTA2 assessment) to Thai version for applying in a paediatric

Table 2. Internal consistency and inter-rater reliability.

Part 1: Thai WOTA1 children with disability (n = 22), Rater 1 vs. Rater 2 at RICD, Chiang Mai^a

Percent agreement between raters

Rater 1 vs. Rater 2

90.9%

Internal consistency (Cronbach's α)

Rater 1

0.92

Rater 2

0.93

Inter-rater reliability

0.92

(ICC, 95%CI)

(0.87 - 0.96)

Part 2: Thai WOTA2 children with typical developing (n = 13), Rater 3 vs. Rater 4 at Hydrotherapy Rehabilitation Center, Naresuan University, Phitsanuloke

Percent agreement between raters

Rater 3 vs. Rater 4

100.0 %

Internal consistency (Cronbach's α)

Rater 3

0.97

Rater 4

0.98

Inter-rater reliability

0.97

(ICC, 95%CI)

(0.91 - 0.99)

^aRajanagarindra Institute of Child Development (RICD), Chiang Mai, Thailand.

Table 3. Interrater agreement of two sets of assessments.**Thai WOTA1; subjects with disability (n = 22)**

Tested item	K_w
1,3	1
2, 4, 5, 10	0.9
6, 8, 9, 12, 13	0.8
11	0.7
7	0.5

Thai WOTA 2; subjects with typical developing (n = 13)

Tested item	K_w
1, 4, 5, 6, 9, 10, 13 to 22, 25, 27	1
23,24	0.9
3,26	0.8
2	0.4
7, 8, 11, 12	NA

Two sets of item-level analysis. Interrater agreement on a 4-ordinal scale: for WOTA1 (13 test items); rating scale 1 to 4 scores; as for WOTA2 (27 test items); rating scale 0 to 3 scores; weight kappa coefficients (K_w) is defined as: 0.4 - 0.6, moderate agreement; 0.6 - 0.8, substantial agreement; 0.8 - 1.0, almost perfect agreement; NA, not available (when weight kappa could not be calculated as all assessor pairs rated the same ordinal scale for all tested children.)

hydrotherapy field. Our phase II study indicated the excellent interrater reliability and internal consistency of the Thai-WOTA1 in Thai children with disabilities and the Thai-WOTA2 in children with typical developing. In our project phase I, some cultural discrepancies regarding semantic equivalence were found and adapted through all stages, for example, a vocabulary used to represent a child/a swimmer in which the original version uses the third person form (s/he). No discrepancies regarding idiomatic or conceptual equivalence were found. The project's key strength was the extensive procedure, including duplicate (forward-backward) translations, expert group discussions, and pre-instrumental tests, which ensured the highest quality of the target version: Thai-WOTA1 and Thai-WOTA2. ⁽²¹⁾

Our preliminary study demonstrated strong interrater reliability, internal consistency, and substantial agreement in test items for both Thai-WOTA1 and Thai-WOTA2. The results were in line with the original study of Tirosh R, *et al.*⁽¹⁴⁾ Thus, the study's findings support the original study's findings. According to Bonett DG ⁽²³⁾, our modest sample sizes were larger than the minimal sample size needed to detect 90.0% power of the test. Thus, according to power calculation ^(22, 23), our sample size for this preliminary study was feasible. Our item-level analysis indicated substantial to almost perfect agreement ($K = 0.7$ to 1.0). Only exception was the moderate agreement on the item 7 in Thai-WOTA1 ($K = 0.5$)

and the item 2 in Thai-WOTA2 ($K = 0.4$). The item 7 (WOTA1) assessed "splashing water," and the scores 3 and 4 indicate whether a child turns his face away from the splashing water (3) or not (4), which might be a difficult point for a rater's interpretation. The item 2 (WOTA2) assessed "blowing bubbles through the mouth over 5 seconds," and the scores 2 and 3 indicate whether a child has moderate (2) or high quality of performance (3), which might be a different interpretation between the raters. A possible explanation for this finding is that the ability to distinguish between these observations might be considered difficult for the rater. Using goggles during the evaluation of this item showed an increase in rater agreement, but this occurred across separate incidents. Thus, the child's behaviour could have changed. Because this item is considered essential for assessing aquatic mental adjustment, we now emphasize the use of goggles in the WOTA2 guidelines.⁽¹⁴⁾

Importantly, Tirosh R, *et al.*⁽¹⁴⁾ recommended that the WOTAs are tests designed for a hydrotherapist, an aquatic therapist/instructor, or a physical therapist who are trained to evaluate the child (swimmers')⁽¹⁴⁾ mental adjustment and function in the water. The forms were developed based on the principles of the Halliwick Concept of the hydrotherapy curriculum.⁽¹⁴⁾ This topic is taught in Thailand at all universities at the undergraduate level. Considerably, the experience of the raters in our preliminary study was acceptable to use Thai-WOTA1 and 2 in such children with and

without motor disabilities. Thus, the differences in working experience and years of clinical service among the Thai WOTA raters (eight years for the WOTA1 raters and three years for the WOTA2 raters) did not affect their ability to use the assessment. The four raters for both parts of our study are experienced physical therapists who work in hydrotherapy pools with patients and clients of all ages.

The strength of this reliability study was, first, that it was a multisite project in which the same research protocol was carried out. The second aspect is that our Thai WOTA assessors may learn and use assessments independently of their professional backgrounds or regions of origin, given their excellent interrater reliability. Third, heterogeneous samples varied from typical developing children to children with special needs, with and without swimming experience. These multi-factors helped us observe all Thai instructional phrases of the test items and all 4-ordinal rating scales within Thai context. The studied children with neuro-motor impairments had a wide range of cognitive abilities, ranging from those who could understand and follow instructions to those who found it challenging to do so.

The only limitation of this study was the type of subjects eligible to participate in the Thai-WOTA2 assessment. We only recruited healthy children who could perform functional tasks, i.e., advanced aquatic activities regarding the WOTA2 assessment form. Our preliminary study had two different characteristics of subjects as we conducted our preliminary study during the COVID-19 pandemic in Thailand, which had an impact on the few hours that clinical services were opened and a few choices of children who were eligible for the study.⁽²⁴⁾ During the research project year 2021, we only found two school-age children with CP at the RICD Center, Chiang Mai, Thailand who could perform the test items of Thai WOTA2 but were not enough for our required sample size. Because in Thailand there were few aquatic programs available and the WOTA2 test items were still too difficult for Thai children with special needs who had occasionally received aquatic therapy, we had few options for recruiting procedures at the constraint time of the study. Thus, we decided to conduct the psychometric study of Thai-WOTA2 in eligible children with typical development. Nonetheless, the basic guidelines for WOTA2 implied that it is intended for anyone starting from 4 to 5 years of age. This recommendation implied the use of WOTA2 in the population of healthy children.⁽¹⁴⁾

Our study indicates that the Thai-WOTA assessments are applicable to many types of the studied children with disabilities (cerebral palsy, Down's syndrome, spina bifida, and spinal muscular atrophy (with type 2 or type 3 SMA) who join hydrotherapy programs or children with typical development starting at 4 years who start learning swimming lessons. The WOTA1 targets individuals with severe cognitive limitation, whereas WOTA2 targets those who can follow instructions.

Thai WOTA1 and Thai WOTA2 are promising tool to contribute to Thai aquatic clinical practice and research purpose. There has previously been no tool adapted to the Thai language that makes it possible to assess and describe the progression of Thai children with disabilities who receive aquatic therapy. This can be a useful outcome measure in the activity and participation domains of the ICF-CY (WHO 2007).⁽¹⁰⁾ In addition, these instruments are applicable to goal setting. Thus, Tirosh R, *et al.* recommended that the WOTA1 and WOTA2 can be used as the objective follow-up of a learner's progress report before and after a hydrotherapy program, including the assessment of a child's change over time.⁽¹⁴⁾

In future research, a study to investigate the Thai WOTA2 should recruit a representative sample of children with developmental disabilities in Thailand. Furthermore, research regarding the assessment of the long-term reliability and validity of the Thai-WOTA1&2 should be implemented. We will encourage the use of Thai WOTA1&2 by every aquatic professional in paediatric field and will be interested in feedback, as well as hoping to see additional research conducted with these instruments.

Conclusion

The preliminary study conducted in Thailand demonstrates excellent reliability in the Thai-WOTA1 and Thai-WOTA2 assessments among Thai children's population. The Thai WOTA1 and Thai WOTA2 are aquatic assessment tools that measure mental adjustment and function in the aquatic environment for children with special needs and young children with typical developing from 4 to 5 years. The tests are clinically relevant and are designed to assess and follow up on the function of children with both motor and cognitive disabilities. The scales have been demonstrated to be reliable.

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Conflicts of interest statement

All authors have completed and submitted the International Committee of Medical Journal Editors Uniform Disclosure Form for Potential Conflicts of Interest. None of the authors disclose any conflict of interest.

Data sharing statement

All data generated or analyzed during the present study are included in this published article. Further details are available for noncommercial purposes from the corresponding author on reasonable request.

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