RESEARCH

# RELİABİLİTY AND VALİDİTY OF THE TOE WALKİNG TOOL İN TURKİSH IDİOPATHİC TOE WALKİNG CHİLDREN


## Abstract

The aim of our study was to determine the reliability and the validity of the Turkish-language version of the Toe Walking Tool (TWT) in idiopathic toe walking children. “Toe Walking Tool” contains 21-items which measure medical, birth & developmental history and assessment. Demographic information of 34 children was recorded. The tool was translated into Turkish with the following translation steps. Internal structure consistency and test-retest reliability were measured for reliability analyses. For each item on the tool, Cronbach’s alpha coefficient and item-total score correlations were calculated. Turkish Version of Toe Walking Tool (TWT-TR) showed good test-retest reliability (ICC: 0.674). Lower and upper bound ranged of Cronbach’s alpha coefficient in the internal structure consistency analysis was calculated between 0.476-0.823. These data suggest that the TWT-TR is a valid and reliable clinical tool in idiopathic toe walking children.



**Key words:** children, disability, function, reliability, toe walking


ARAŞTIRMA

# İDIOPATIK PARMAK UCU YÜRÜYEN ÇOCUKLARDA “TOE WALKING TOOL” ÖLÇEĞİNIN TÜRK TOPLUMUNDA GEÇERLİĞI VE GÜVENIRLİĞI


## Öz

Çalışmamızda amacımız idiopatik parmak ucu yürüyen çocuklarda “Toe Walking Tool (TWT)” ölçeğinin Türkçe versiyonu ile geçerlik ve güvenirliğini belirlemektir. “Toe Walking Tool” tıbbi, doğum ve gelişim öyküsünü ve değerlendirmeyi ölçen 21 maddeyi içerir. 34 çocuğun demografik bilgileri kaydedildi. Ölçek çeviri adımlarıyla Türkçeye çevrildi. Güvenilirlik analizleri için iç yapı tutarlılığı ve test-tekrar test güvenilirliği kullanılmıştır. Her bir madde için Cronbach alfa katsayısı ve madde-toplam puan korelasyonları hesaplanmıştır. “Toe Walking Tool”’un Türkçe Versiyonu (TWT-TR) iyi test-tekrar test güvenilirliği göstermiştir (ICC: 0,674). İç yapı tutarlılık analizinde Cronbach alfa katsayısının alt ve üst sınır aralıkları 0,476-0,823 arasında hesaplanmıştır. Sonuçlarımız TWT-TR’nin idiyopatik parmak ucu yürüyen çocuklarda geçerli ve güvenilir bir klinik ölçek olduğunu göstermiştir.



**Anahtar Sözcükler:** bozukluk, çocuk, fonksiyon, geçerlik, parmak ucu yürüme



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## 1. Introduction

The toe walking, is a common pattern in healthy children under 3 years of age. It is mostly characterized by the absence of full foot contact during standing. Heel strike is insufficient during the first contact phase of the gait cycle in toe walking (1). Weight bearing and transferring is not seen in toe walking (2). Frequently, toe walking is associated with cerebral palsy (CP), muscle disoders, Charcot Marie-Tooth disease and autistic spectrum disorders (3).

Idiopathic toe walking (ITW) is used for children older than 3 years without any known cause or pathology after excluding neurologic, orthopedic and psychiatric causes (4). Limited dorsi flexion, has been often reported in ITW (5). Generally this limitations increases with age, and other musculoskeletal abnormalities such as prolonged pelvic tilt, genu valgum, genu recurvatum, and/or external tibial torsion accompany in this process (6). There was also leg pain (7). Clinical observation of preschool childrens' walking diagnosed with ITW demonstrates the characteristics of toddler walking (like running constantly, poor adjustment of steps when walking, jumping and bouncing instead of controlled stepping, etc.). Idiopathic toe walkers' walking is symmetrical, symptoms are mostly intermittent, and they tend to resolve on their own within a few weeks or months. Children who diagnosed with ITW walk on tiptoes, but when they concentrate on their walking or when requested they can show foot contact (8). According to the results of many studies, children have a family history. In fact, the significant number of family histories suggests that there may be a hereditary condition involving abnormal neurological factors (9). In another study, in patient demographics of the family history incidence was 34.1% and male involvement was 68.2%. The diagnosis is not gender specific, it is seen in both girls and boys (10).

Currently a variety of standardized assessment tools are used to predict problems and symptoms, preventing the occurrence of the disease and/or preventing the clinical condition from worsening if it occurs. Clinical prediction tools need to be externally validated to ensure their generalizability, accuracy, and clinical utility. The aim of our study was to determine the reliability and validity of the Turkish-language version of the Toe Walking Tool (TWT-TR) in idiopathic toe walking children.

## 2. Material and Method

### *2.1. Design*

Our study was evaluated by University Non-invasive Clinical Research Ethics Committee and found to be ethically appropirate with the desicion number as 2011-KAEK-42-1/1 and was registered in the Clinical Trial Register (ClinicalTrials.gov Identifier: NCT03596021). The permission required for the application of the Turkish Version of TWT was obtained at the beginning of the study from the licensee. All children and their parents who agreed to participate in the study were informed about the study and written informed consent was received from all.

### *2.2. Participants*

The study was conducted at the our university, from the Faculty of Medicine, Department of Child Health and Disease, Divison of Pediatric Neurology. Inclusion criterias for the children were: (1) having been diagnosed with ITW by pediatric neurologist, (2) being between 4-8 years of age, (3) being volunteer to participate in the study, (4) having no any other diagnosis (e.g. cerebral palsy, neuromuscular disease etc.)

### 2.3. Outcomes

#### *2.3.1. Demographic Information Form*

A demographic information form was completed by researcher verbally. Information included the childrens' age, gender, height, weight, side of dominant extremity, use of orthoses, history of botulinum toxin, use and duration of baby-walker.

#### *2.3.2. "The Toe Walking Tool" (TWT)*

The Toe Walking Tool (TWT) was developed by Cylie M.Williams in 2010, contains 21 items which measure medical history (5 items), birth & developmental history (4 items) and

assessment (12 items) in children aged between 4-8 years old. This tool is designed to exclude a medical reason for toe walking gait. A YES response for any question indicates a child should be referred for specialist assessment of the toe walking gait. This tool has been modified from a toe walking assessment used with toe walking children between the ages of 4-8 years. Caution interpreting results outside these ages should be considered. This assessment tool is not to replace professional opinion and if the clinician is unsure of the result, a YES response should be indicated. TWT is a valid and reliable questionnaire for evaluating finger-tip walking. However, it should be noted that this questionnaire does not have precise implications for the diagnosis of ITW, it primarily determines healthy children walking tip-toe. In fact, some children can be identified as having a risk factor associated with a medical condition, but ITW can be diagnosed with further specialized research. A careful and systematic history and evaluation involving the use of TWT can help a team of health clinicians to guide children walking tip-toe for further medical research (11).

#### *2.3.3. Observational Gait Analysis (OGA)*

Observational gait analysis (OGA) is applied to evaluate childrens' gait. Observational gait assessment using naked eye or video images is preferred to computed gait analysis in clinical practice. It can be used more frequently in clinics due to its ease of use and accessibility. By this research observational gait analysis scale validated on children who have neurological and neuromuscular disorders. This scale was modified based on 'Physicians Rating Scale' to assess the margins of children who have hemiplegic cerebral palsy. The scale consists of 7 parameters in a table and the scores of these parameters with the categories 1-3. The total scores ranged between 7-21 (12,13). Videotaping of walking has increase the observational skills of therapists as it allows the video to be frozen at certain frames during the evaluation or to be watched repeatedly at slower speeds. The advantages of taking video to the children; they have get less tired, their frequency of repetitions have decrease, they have be able to see their performances in the video, and they have be more careful against deviations. The disadvantage of observation has; especially the presence of video cameras causes the children to be aware of their performance and to modify their walking pattern to give a good image (14).

### *2.4. Procedures*

Demographic datas of the children were recorded. TWT was applied to determine the causes of ITW. For the determination of test-retest reliability, TWT was re-administered a week after the initial evaluations. All the evaluations were carried out by a single researcher (MT) a single face-to-face session with children. Following the second evaluation of the children to determine the inter-rater reliability and a third evaluation was carried out on them by another researcher (BT) 10 days after the first two evaluations.

#### *2.4.1. Translation and Cross-Cultural Adaptation*

The TWT was adapted from English version into Turkish in accordance with its standard methodology recommended by Guillemin et al (15). The adaptation was performed by two independent native speaking Turkish translators with fluent knowledge of English. The final Turkish version of the adaptation was later translated from Turkish to English by two English native speakers who can speak Turkish fluently to check compatibility. A committee with expertise in this field reviewed the translations and the procedure. The comparison of the translation to the original version of the test revealed no inconsistency.

### *2.5. Data Analysis*

IBM SPSS Statistics for Windows version 23.00 was used for statistical analysis of the data. The Kolmogorov-Smirnov Test was used to determine whether the data showed normal distribution. Categorical variables were expressed as numbers and percentages, whereas quantitative data were expressed as mean and standard deviation.

#### *2.5.1. Validity Analysis*

A construct validity was used for the determine validity degree of TWT. Construct validity refers to the degree to which inferences can legitimately be made from the operationalizations in study to the theoretical constructs on which those operationalizations were based. Since the normal distribution assumption could not be obtained, the tool scores were analyzed with Mann Withney U Test to see whether statistical significance level was accepted to be $p<0.05$.

#### *2.5.2. Reliability Analysis*

In our study, internal consistency and item analysis methods were used for the analysis of the reliability of the tool, and test-retest method and inter-rater reliability method were used for the invariance reliability over time. Internal consistency has been indicated as Cronbach's alpha value. An alpha value greater than 0.70 is indicative of a satisfactory consistency, while values between 0.50 and 0.70 mean acceptable consistency. In our study, mixed model of Intra-class Correlation Coefficiant (ICC) was used for the inter-rater and test-retest reliability analyses of TWT. Intervals used for the interpretation of ICC values; if values are lower than 0.5, this means poor reliability; values between 0.50 and 0.74 mean moderate reliability; values between 0.75 and 0.90 fine reliability; and values greater than 0.90 are defined as excellent degree of reliability (16). Kappa with linear weighting (with 95% confidence inter-vals [CI]) was used to determine the intra- and inter-rater reliability of the TWT. Kappa statistics were definedas follows: <0.20, poor; 0.21 to 0.40, slight agreement;0.41 to 0.60, fair; 0.61 to 0.8, good; 0.81 to 0.91, verygood; and >0.92, excellent agreement (17).

## 3. Results

### *3.1. Descriptive Statistics*

The mean age of children was 5.38±2.05 years included in the study. Totally 6 (17.7 %) children have orthoses (2 of use ankle-foot orthosis and 4 of them use carbon fiber footplate) for control the walking which more acceptable from the patient and parents. The mean values of demographic and clinic characteristics were presented in Table 1.

### *3.2. Validity*

Construct validity results of TWT were found to be significantly better, and the sub-results of the construct validity and TWT-TR scores were shown in Table 2.

### *3.3. Reliability*

- Internal Consistency Reliability: As a result of statistical analysis, the internal consistency of TWT was found to be sufficient statistically. The results of the internal consistency and item analysis of the test were shown in Table 2.
- Test-Retest Reliability: Total score of the TWT-TR were found to be moderately reliable (ICC=0.674 (95% confidence interval [CI], 0.476-0.823). The invariance reliability sub-results of TWT-TR over time were given in Table 2.
- Inter-Rater Reliability: All sub-tests of TWT-TR were found to be perfectly reliable (r=0.827; p=0.000).

### *3.4. Correlation*

The correlation results between "The Toe Walking Tool" (TWT) and "Observational Gait Analysis" (OGA) were shown in Table 3.

## 4. Discussion

This study describes the translation and testing in terms of validity (construct) and reliability (Internal consistency, Test-Retest, Inter-Rater) of the Turkish version of the TWT in idiopathic toe walking children. This research shows that the Turkish version of the TWT is a valid and reliable tool to assess impaired functions, pyhsical limitations, and clinical characteristics of children who have toe walking. The original English version of the TWT has been also shown as a reliable instrument for toe walking children.

The validition of the data obtained from an investigation depended on the suitability for measurement purposes. The vehicle must not contain materials that are not relevant for measurement purposes and the materials must

not be insufficient at the same time (18). The toe walking has been seen as valid and reliable in our clinical use on the Toe Walking Tool specifically developed on children who can ability of walking. Thus, the tools developed specifically for the subject disease, are valuable. A special scales/tools/indexes should be developed for the symptoms (19).

In physical measurements, the indisputable concrete informations such as strength, size, and weight of the children are obtained. The Toe Walking Tool reflects the physical status and clinical knowledge of the children that has been assessed. This can be influenced by the clinical differences between the evaluators, but the results are been close to each other. When the concepts of reliability and validity are used together, mean standardization are the same simultaneously. The high degree of validity and reliability leads to generality. There is also a relevance which can be defined as the product of the reliability, and the reliability which is called the relevancy (20). Also, our validation research reveals that this tool is generalized to the clinic and is related to the daily routine.

Assessment is the first step of the correct treatment. To assess the effects of conservative and surgical interventions on gait normalisation, identifying the ankle range of motion, and pain of children which are adverse effects of the interventions and the frequency of recurrence, are so important (21,22).

The version of the TWT in a different language Lopez-Bustos-de-Las-Heras et al. in 2019 and found the global content validity index (0.94). In the study using Delphi method, 15 professionals concluded that the Spanish version of TWT is valid and reliable (23).

### 4.1. Study Limitations

Due to the limitation of time in our study, adequate number of participants could not be included in the study to make a better distribution analysis according to the ages, which can be regarded as a limitation of our study. When the methodology of other studies in the literature is examined, it can be seen that results are introduced according to age distributions. Taking into consideration the fact that distribution by age can provide positive contributions in the interpretation of evaluations that have been made by experts working in the clinical field, it is thought that examining those distributions according to ages in the following studies will be crurial. And, we were unable to divide the patients into any groups to measure the effects of toe walking. We believe that further studies should be required to confirm our findings. The intra- and inter-rater reliability of the TWT-TR is comparable to the established reliability of the original English-language version. Considering the fact that studies conducted in this area focus largely on healthy groups, it is thought that it will contribute positively to the development of furher study fields to assist both academic and clinical professionals. It is considered essential that further studies where TWT is used should be conducted to obtain validity and reliability as well as high value of evidence in clinical practices.

## 5. Conclusion

The walking is substantial of lower extremity utilization in daily living activities. The walking evaluation in children with toe walking should comprehensive in sides. In studies, method was planned by the tools/scales/instruments distinguished with properly items.

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## References


1. Crenna P, Fedrizzi E, Andreucci E, Frigo C, Bono R. The heel-contact gait pattern of habitual toe walkers. Gait Posture. 2005;21(3):311–7.
2. Perry J, Burnfield JM, Gronley JK, Mulroy SJ. Toe walking: Muscular demands at the ankle and knee. Arch Phys Med Rehabil. 2003;84(1):7–16.
3. Engelbert R, Gorter JW, Uiterwaal C, van de Putte E, Helders P. Idiopathic toe-walking in children, adolescents and young adults: a matter of local or generalised stiffness?. BMC Musculoskelet Disord. 2011;12(1):61.
4. Martín-Casas P, Ballestero-Pérez R, Meneses-Monroy A, Beneit-Montesinos JV, Atín-Arratibel MA, Portellano-Pérez JA. Neurodevelopment in preschool idiopathic toe-walkers. Neurología. 2017;32(7):446-54.
5. Brouwer B, Davidson LK, Olney SJ. Serial casting in idiopathic toe-walkers and children with spastic cerebral palsy. J Pediatr Orthop. 2000;20(2):221–5.
6. McMulkin ML, Baird GO, Caskey PM, Ferguson RL. Comprehensive outcomes of surgically treated idiopathic toe walkers. J Pediatr Orthop. 2006;26(5):606–11.
7. Hirsch G, Wagner B. The natural history of idiopathic toe-walking: a long-term follow-up of fourteen conservatively treated children. Acta Paediatr. 2004;93(2):196-9.
8. Newman CJ, Ziegler AL, Jeannet PY, Roulet-Perez E, Deonna TW. Transient dystonic toe-walking: differentiation from cerebral palsy and a rare explanation for some unexplained cases of idiopathic toe-walking. Dev Med Child Neurol. 2006;48(2):96–102.
9. Hemo Y, Macdessi SJ, Pierce RA, Aiona MD, Sussman MD. Outcome of patients after Achilles tendon lengthening for treatment of idiopathic toe walking. J Pediatr Orthop. 2006;26(3):336–40.
10. Williams CM, Tinley P, Curtin M, Wakefield S, Nielsen S. Is idiopathic toe walking really idiopathic? The motor skills and sensory processing abilities associated with idiopathic toe walking gait. J Child Neurol. 2014;29(1):71-8.
11. Williams CM, Tinley P, Curtin M. The Toe Walking Tool: a novel method for assessing idiopathic toe walking children. Gait Posture. 2010;32(4):508–11.
12. Toro B, Nester C, Farren P. A review of observational gait assessment in clinical practice. Physiother Theory Pract. 2003;19(3):137–49.
13. Martin K, Hoover D, Wagoner E, et al. Development and Reliability of an Observational Gait Analysis Tool for Children with Down Syndrome. Pediatr Phys Ther. 2009;21(3):261-8.
14. Borel S, Schneider P, Newman CJ. Video analysis software increases the interrater reliability of video gait assessments in children with cerebral palsy. Gait Posture. 2011;33(4):727–9.
15. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. J Clin Epidemiol. 1993;46(12):1417-32.
16. Koo TK, Li MY. A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. J Chiropr Med. 2016;15(2):155–63.
17. Grouven U, Bender R, Ziegler A, Lange S. Der kappa-koeffizient. Dtsch Med Wochenschr. 2007;132(1):65-8.
18. Sinha I, Jones L, Smyth RL, Williamson PR. A systematic review of studies that aim to determine which outcomes to measure in clinical trials in children. Plos Med. 2008;5(4):e96.
19. Varni J, Limbers CA, Burwinkle TM. How young can children reliably and validly self-report their health-related quality of life?: An analysis of 8,591 children across age subgroups with the PedsQL™ 4.0 Generic Core Scales. Health Qual Life Out. 2007;5(1):1.
20. Bashir M, Afzal MT, Azeem M. Reliability and validity of qualitative and operational research paradigm. Pak J Stat Oper R. 2008:35-45.
21. Turhan E, Demirel M, Daylak A, Huri G, Doral MN, Çelik D. Translation, cross-cultural adaptation, reliability and validity of the Turkish version of the Olerud-Molander Ankle Score (OMAS). Acta Orthop Traumato. 2017;51(1):60-4.
22. Williams CM, Pacey V, de Bakker PB, Caserta AJ, Gray K, Engelbert RHH. Interventions for idiopathic toe walking (Protocol). Cochrane Db Syst Rev. 2016;10:CD01236.
23. Lopez-Bustos-de-Las-Heras R, Cano-de-la-Cuerda R, de-la-Llave-Rincon AI, Guerrero-Blazquez A, Plaza-Manzano G, Martin-Casas P. Translation and transcultural adaptation of the Toe Walking Tool: screening tool of toe walking patients. Rev Neurologia. 2019;69(3):99–108.
24.

**Table 1:** The Mean Values of Demographic and Clinic Characteristics

| | | |
|---|---|---|
| Number of children, n | 34 | |
| Gender | M,50 %; F,50 % | |
| Side of Dominant Extremity | R,76.5 %; L,23.5 % | |
| Use of Orthoses | 17.7 % | |
| History of Botulinum toxin | 20.6 % | |
| Use of Baby-Walker | 85.4 % | |
| | **Mean±SD** | **Range** |
| Age (years) | 5.38±2.05 | 4-8 |
| Height (centimeter) | 112.40±26.50 | 82-159 |
| Weight (kg) | 19.13±11.71 | 2-63 |
| Body Mass Index (BMI) (kg/m$^2$) | 20.83±6.83 | 16-24 |
| Duration of Using Baby-Walker (months) | 3.18±1.99 | 0-7.5 |

n=Number, M=Male, F=Female, R=Right, L=Left, SD=Standart Deviation

**Table 2:** The Intra-class Correlation Coefficiant Results of Toe Walking Tool Turkish Version

| Toe Walking Tool | ICC | 95% CI | *p* |
|---|---|---|---|
| Medical History | 0.558 | 0.423-0.684 | 0.001 |
| Birth & Developmental History | 0.679 | 0.553-0.772 | 0.001 |
| Assessment | 0.685 | 0.526-0.772 | 0.001 |
| Total | 0.674 | 0.476-0.823 | 0.001 |

ICC= Intra-class Correlation Coefficiant

**Table 3:** The Relationship Results of Between The Observational Gait Analysis and The Toe Walking Tool Turkish Version

| | | **Observational Gait Analysis** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **Total** |
| **Toe Walking Tool** | Medical History | -.236 | -.178 | .189 | -.037 | .356 | .156 | .256 | .268 |
| | Birth & Developmental History | .125 | .069 | .197 | .055 | -.288 | -.252 | -.113 | .253 |
| | Assessment | -.320 | -.431* | -.039 | -.377* | -.198 | -.045 | -.062 | .167 |

The 1-7 indicates that the part of the observational gait analysis; 1= Hip joint in terminal posture, 2= Hip joint in mid-swing phase, 3= The maximum degree of extension in the stance during terminal stance phase, 4= Maximum flexion in the swing phase, 5= First foot contact, 6= Foot contact during posture (Charging), 7= Timing of heel lift. *p<0.05