

Timed Floor to Stand-Natural: Reference Data for School Age Children

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Purpose: To collect reference data for the Timed Floor to Stand-Natural (TFTS-N) on a large, diverse sample of school children who are typically developing, taking into account age, sex, and body mass index (BMI). **Methods:** Five physical therapists administered the TFTS-N on a sample of convenience of 1476 school children who were typically developing, aged 5 to 14 years (male = 637, female = 839), using previously tested, standardized reliable procedures. **Results:** The average time ranged from 7.91 ± 1.65 seconds to 8.98 ± 1.62 seconds; 8 year-old students were the quickest and the 13-year-old students were the slowest. The mean difference between males and females was clinically negligible at 0.38 seconds. Post hoc analyses revealed no significant differences among BMI categories. **Conclusions:** Reference data for the TFTS-N test are now available. Neither sex nor BMI affects the timing of the task in this age range. (Pediatr Phys Ther 2016;28:71–76) **Key words:** activities of daily living, age factors, body mass index, child, female, human, male, motor performance, motor skills, reference values, sex factors

INTRODUCTION

The Timed Floor to Stand-Natural (TFTS-N) measures the time to complete the functional task of transitioning from sitting on the floor, to walking a short distance at a natural pace, and returning to sitting on the floor.¹ The TFTS-N was adapted from the Timed Floor to Stand (TFTS), to be used as a stand-alone test for children in school environments. The TFTS was originally adapted from the Timed Up and Go, where the starting position is sitting on a bench² rather than the floor, and participants are encouraged to walk as fast as possible. Currently, to our knowledge, norms for the TFTS-N or the TFTS as stand-alone tests for children with typical development (TD)

have not been reported that also account for differences in age, sex, or body mass index (BMI).

The TFTS has been used as 1 of the 14 items on the physical performance measure (PPM) for mucopolysaccharidosis type 1³ and as 1 of the 8 items on the revised PPM.⁴ Haley et al⁴ established the reliability and normative values for the revised PPM on both children with mucopolysaccharidosis type 1 and a small sample of children with TD (n = 150) representing the age range of 5 to 22 years. The TFTS results are reported for the group mean age of 11 years (standard deviation = 4.5 years) without a breakdown by year, sex, or BMI. The TFTS has been used as a stand-alone test to measure the effect of aquatic exercises on 20 children with various disabilities.⁵ The average time on the TFTS for this sample is also reported as a group mean and is approximately double that of the average time established by Haley et al⁴ for the children with TD, reinforcing differences between children with and without disabilities, but without breakdowns by age, sex, or BMI.

The TFTS was modified to the TFTS-N for “natural” pace transitions.¹ Participants were asked to walk at a natural pace and the timing began at “go” instead of when movement to initiate the transition was visible. The TFTS-N guidelines reflect typical school behaviors in which

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students are not allowed to run and are expected to stand up on the teacher's request. The TFTS-N has an acceptable range of intratester reliability (intraclass correlation coefficient [ICC] (3,1) = 0.713-0.800), strong intertester reliability (ICC (3,1) = 0.988), and test-retest reliability (ICC (3,3) = 0.871).¹

The TFTS-N has face validity as it measures the activity of transitioning to and from the floor and walking a short distance. Students perform this activity throughout the school day, including but not limited to circle time, small groups, and physical education floor spots. First-grade students with TD were observed to transition 15 to 20 times per day,⁶ and prekindergarten children may spend up to 25% of their day transitioning within the classroom.⁷ Teachers reported that it is "very important" or "essential" for students to be able to transition independently in the school and classroom environments for school success,⁶ with the focus on the speed of the transition rather than the movement strategies.⁸ The transition from floor to stand is included in the School Functional Assessment in the domain of *Maintaining and Changing Positions*, with 2 items: "moves from floor to chair or wheelchair" and "raises self from floor to standing position."⁹ The TFTS-N may be useful to physical therapists (PTs) as a tool to help determine functional status and goals for therapeutic intervention.

Physical therapists in school settings require reliable and valid examination tools to assess functional activities. The Individuals with Disabilities Education Act states in Section 300.304 (part b.1) that when conducting an evaluation, the clinician must use "a variety of assessment tools and strategies to gather relevant functional, developmental, and academic information about the child" and that these tools should be "used for the purposes for which the assessments or measures are valid and reliable" (part c.iii).¹⁰ School-based PTs use these tools to determine skill delays and to set intervention goals; therefore, it is important to have normative values for tests and measures to assess function that are contextually relevant to school settings. Normative TFTS-N data by age and sex for children with TD would be useful to PTs to determine whether children with disabilities perform this transition in a manner functionally equivalent to their age and sex-matched peers.

The purpose of this study was to establish reference data for the TFTS-N on a large and diverse population of urban school children taking into account age, sex, and BMI.

METHODS

Study Design

This study was part of a larger cross-sectional study to collect reference data for 5 standardized tests, including the Timed Up and Down Stairs, the Timed Up and Go, the 30-Second Walk Test, and the Shuttle Run; only the TFTS-N procedures and results are presented in this article. Five PTs working for the New York City Department of Education (NYCDOE), each with a minimum of 10 years of experience, volunteered to administer the tests. They completed

the basic training course "protecting human research participants" from the National Institutes of Health (<https://phrp.nihtraining.com/users/login.php>). The NYCDOE Institutional Review Board approved the study. Interrater reliability for the TFTS-N among the 5 testers was previously established as strong (ICC (3,1) = 0.988).¹

Subjects

One hundred thirty-eight NYC public schools were invited to participate in the study. Parent consent forms and student information sheets were distributed to the participant schools before testing. Students from general education classes, aged 5 to 17 years, were eligible for the study. Exclusion criteria included having an Individual Educational Program (IEP) indicating that the student receives special education or related services, lack of parent/guardian consent, a history of orthopedic surgery or injury in the last 6 months, or a history of a genetic or neurological disorder.

Procedures and Data Collection

Students with completed parent consent forms and information sheets participated in either 1 or 2 days of testing in a designated area of either their school gym or a hallway. Each student was given a folder with an assent form to sign and a data collection sheet to be completed by a tester. All folders and forms were coded with identification numbers to ensure anonymity. Student height and weight were measured to determine BMI. Five hundred thirteen students were measured with both their shoes on and off. Height was measured with a Charder HM200P PortStad Stadiometer. Students stood in shoes, hair and accessories were flattened or removed, and height was recorded to the nearest one eighth of an inch. Weight was measured using a Lifesource Precision Health Scale ProFIT/IntelliSCALE (UC-321) and recorded to 2 decimal places. Outer garments and heavy items in pockets were removed. BMI percentiles and categories were calculated using an online BMI calculator for ages 2 to 20 years (www.blubberbuster.com/height_weight.html). Although a statistical difference was found between the shoe conditions for BMI measures ($t(512) = -22.478$; $P < .000$), the average difference of 0.31 was considered functionally insignificant because one third of a BMI point would not move many children into a different BMI category. Thus, only data from the "shoes on" condition are presented. We consider this to be contextually appropriate, as students generally wear shoes when transitioning within the school environment.

The test setup and protocols followed those in the TFTS-N reliability study.¹ Two pieces of tape were placed on the floor 3 m apart. Before testing, an explanation and demonstration of the test was given to each group of 10 students or fewer who were positioned to clearly hear and see the demonstration. After the demonstration, the students lined up single file, 3 ft behind the start line, and

waited to be tested individually. Laminated cue cards with printed test instructions were used to administer the test to ensure the consistency of prompts among the testers. The instructions were “When I say go, stand up, walk to the line, turn around, walk back to the starting line, and sit back down, crisscross applesauce” (for 5- to 8-year-olds), or “with your legs crossed” (for 9- to 17-year olds). “Walk, don’t run. 1, 2, 3, GO.” Each student was allowed to select the manner by which they transitioned between sitting and standing. After 1 trial was completed, the student went to the back of the line to await a second trial. Even though test-retest reliability between 2 trials of the TFTS-N had been established,¹ the testers felt 2 timed trials were important to ensure that the performance variability typical of children was captured in the normative data. A trial was repeated if the student did not pass the second line with both feet, did not sit back down behind the starting line with their legs crossed, or ran, tripped, or fell. It was acceptable to have 1 foot step over the line with the second foot swinging through without landing as long as the student’s entire body passed the line. Students were given unlimited trials to complete the test according to the guidelines. The repeated trials were done immediately after the failed trial. There were no concerns about fatigue or motor learning as the task is a familiar activity that is performed multiple times a day.

Data Analyses

All data were analyzed using SPSS Version 20. Descriptive analyses were run for the TFTS-N by age, sex and BMI, ethnic distribution, and frequency of trials. Paired *t* tests were used to determine differences between the first and second trials and a Pearson *r* was calculated to determine how closely the 2 trial times correlated within ages and overall. Independent *t* tests were used to compare male and female TFTS-N times, and a one-way analysis of variance with Bonferroni post hoc analyses was used to compare TFTS-N times across BMI categories within age groups.

RESULTS

Of the 138 NYCDOE schools contacted, 25 agreed to participate representing all 5 city boroughs. Five school sites were eliminated because of incomplete consent or student information forms, or insufficient number of students per school. A sample of convenience of 1650 students was recruited from 20 elementary and middle schools, with 1476 completing the TFTS-N—637 males and 839 females. One hundred seventy-four were excluded secondary to a student’s inability to follow directions, absence the day of testing, relocation to another school, having an IEP, refusal to participate, and scheduling conflicts. The sample included students ranging from age 5 to 14 years and was ethnically diverse (Figure 1), with 433 (29.3%) whites, 359 (24.3%) Asians/Pacific Islanders, 299 (20.3%) Latinos/Hispanics, 235 (15.9%) blacks/African Americans,

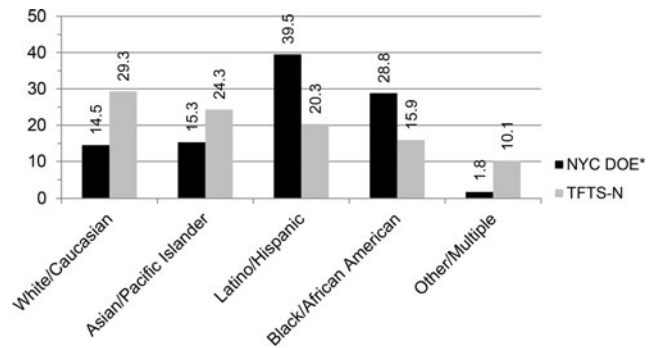


Fig. 1. Ethnic distribution of NYCDOE* versus TFTS-N study. NYCDOE indicates New York City Department of Education; TFTS-N, Timed Floor to Stand-Natural. *As per the NYCDOE 2011 to 2011 demographic data.

and 150 (10.1%) reporting other/multiple. Compared with the NYCDOE demographic profile,¹¹ the sample had a slightly larger representation of Asian/Pacific Islanders and white students, and slightly less representation of Latino/Hispanic and black/African American students. All age groups were well represented except for the 14-year-old group (*n* = 11). Table 1 presents the average times for the TFTS-N by sex and age in years. The average TFTS-N times across age groups ranged from 7.91 ± 1.65 seconds to 8.98 ± 1.62 seconds, with an overall difference of 1.06 seconds. The first trial was completed on the first attempt by 86.18% of the sample, and the second trial was completed on the first attempt by 92.95%. Less than 2% of the students required 3 or 4 attempts for either trial (Table 2).

The average time of the first trial of the TFTS-N for all ages was $M = 8.38 \pm 1.61$, and $M = 8.21 \pm 1.63$ for the second trial. There was a strong positive correlation between trials 1 and 2 for all ages ($r = 0.794$; $n = 1476$; $P = .000$), indicating that performances were reasonably consistent. In addition, the correlations within age groups trend upward with increasing age, suggesting greater consistency between the 2 trials as children get older (Table 3). The overall difference in average time between trials 1 and 2 was only 0.17 seconds. A paired *t* test between the 2 trials resulted in a statistical difference ($t(1475) = 6.132$; $P < .000$) that was not considered clinically significant, so the times for trials 1 and 2 were averaged for all remaining analyses. Use of the average performance for each child ensured a typical performance time. Independent *t* tests yielded no differences between males and females within each age by year.

Individual BMI levels were categorized on the basis of the Center for Disease Control’s 4 definitions; *underweight* if BMI is less than the fifth percentile, *healthy* if BMI is between the fifth and 85th percentiles, *overweight* if BMI is between the 85th percentile and less than 95th percentile, and *obese* if BMI is equal to or more than the 95th percentile.¹² In this sample, 4.1% were underweight, 63.7% were healthy, 16.3% were overweight, and 15.9% were obese (Table 4). The analysis of variance suggests that 8-, 10-, and 12-year-olds with a *healthy* BMI ranking

TABLE 1

TFTS-N Times in Seconds for Sex and Age in Years (n = 1476)

Age, y	Sex	n	Mean $\pm$ SD	Minimum	Maximum
5	Male	85	8.85 $\pm$ 1.36	5.11	12.90
	Female	98	9.07 $\pm$ 1.92	4.10	18.30
	Total	183	8.97 $\pm$ 1.68		
6	Male	121	8.42 $\pm$ 1.44	4.94	12.63
	Female	118	8.66 $\pm$ 1.56	5.45	13.93
	Total	239	8.54 $\pm$ 1.50		
7	Male	87	8.23 $\pm$ 1.41	5.28	11.41
	Female	127	8.51 $\pm$ 1.62	4.83	13.50
	Total	214	8.40 $\pm$ 1.54		
8	Male	100	7.67 $\pm$ 1.59	4.37	11.64
	Female	95	8.17 $\pm$ 1.68	5.36	13.11
	Total	195	7.91 $\pm$ 1.65 ^a		
9	Male	73	7.62 $\pm$ 1.26	4.58	10.22
	Female	131	8.16 $\pm$ 1.44	5.42	13.05
	Total	204	7.96 $\pm$ 1.40		
10	Male	67	7.60 $\pm$ 1.24	5.22	10.45
	Female	111	8.15 $\pm$ 1.36	5.47	11.93
	Total	178	7.94 $\pm$ 1.34		
11	Male	52	7.75 $\pm$ 1.46	5.25	12.34
	Female	47	8.46 $\pm$ 1.18	5.77	11.38
	Total	99	8.08 $\pm$ 1.38		
12	Male	37	8.01 $\pm$ 1.39	4.34	10.43
	Female	74	8.40 $\pm$ 1.23	5.52	13.28
	Total	111	8.23 $\pm$ 1.21		
13	Male	11	8.79 $\pm$ 1.34	6.48	11.46
	Female	31	8.88 $\pm$ 1.53	6.87	14.33
	Total	42	8.98 $\pm$ 1.62 ^b		
14	Male	4	7.61 $\pm$ 0.83	6.83	8.69
	Female	7	8.65 $\pm$ 1.67	7.36	12.27
	Total	11	8.27 $\pm$ 1.40		

Abbreviations: SD, standard deviation; TFTS-N, Timed Floor to Stand-Natural.

^aFastest average age group time.^bSlowest average age group time.

TABLE 2

Frequency of Trials to Complete the TFTS-N

Trials, n	Trial 1 n (%)	Trial 2 n (%)
1	1272 (86.18)	1372 (92.95)
2	182 (12.33)	102 (6.91)
3	23 (1.59)	4 (0.27)
4	2 (0.14)	1 (0.07)

Abbreviation: TFTS-N, Timed Floor to Stand-Natural.

were significantly faster by approximately 1 second than students ranked as *obese* ($P < .05$) in TFTS-N times (Table 4).

DISCUSSION

This cross-sectional study provides reference values for the TFTS-N for a large diverse, urban sample of children with TD ages 5 to 14 years. Age group average performances range between 7.91 $\pm$ 1.65 seconds and 8.98 $\pm$ 1.62 seconds—an overall difference of 1.06 seconds. Even though the sample for 14-year-olds is small, the 1.06-second difference across 5- to 13-year age groups suggests that the times for the 14-year-old group are rea-

TABLE 3

Correlations of TFTS-N Trial 1 With Trial 2 by Age

Age, y	n	Pearson r	P Value
5	183	0.713	.000
6	239	0.737	.000
7	214	0.783	.000
8	195	0.880	.000
9	204	0.798	.000
10	178	0.797	.000
11	99	0.804	.000
12	111	0.830	.000
13	42	0.916	.000
14	11	0.901	.000
Overall	1476	0.794	.000

Abbreviation: TFTS-N, Timed Floor to Stand-Natural.

sonable. Eight-year-old children performed the TFTS-N in the shortest time, whereas the 13-year-old group took the longest time to complete the test. There was no statistical difference between girls and boys of the same age, so the total average scores can be used as reference ranges for each age group (Table 1). Of note, the range of times within each age group is greatest among the younger children, and narrows as the children get older. Five- and 6-year-old children vary 7 to 14 seconds in their performances,

TABLE 4

ANOVA: BMI Category, Age, and TFTS-N Times in Seconds (n = 1476)

BMI Category									
Age (years)	Underweight BMI <18.5		Healthy BMI 18.5-24.9		Overweight BMI 25.0-29.9		Obese BMI >30.0		P Value
	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	
5	7	8.19 ± 1.17	123	8.98 ± 1.71	27	8.80 ± 1.72	26	9.34 ± 1.58	.379
6	15	8.69 ± 1.89	168	8.46 ± 1.50	27	8.47 ± 1.57	29	8.96 ± 1.21	.404
7	6	8.90 ± 2.09	144	8.26 ± 1.52	21	8.62 ± 0.99	43	8.68 ± 1.72	.304
8	9	7.88 ± 1.83	127	7.69 ± 1.43 ^a	24	7.66 ± 1.55	35	8.91 ± 2.06 ^a	.001
9	7	7.79 ± 0.79	120	7.86 ± 1.41	46	7.95 ± 1.40	31	8.43 ± 1.45	.237
10	6	7.30 ± 0.86	109	7.72 ± 1.36 ^a	39	8.30 ± 1.24	24	8.51 ± 1.25 ^a	.008
11	1	7.53 ± 0.00	60	7.83 ± 1.23	24	8.01 ± 1.21	14	9.34 ± 1.65	.002 ^b
12	7	8.29 ± 1.57	63	7.92 ± 1.12 ^a	17	8.39 ± 1.01	23	8.94 ± 1.19 ^a	.005
13	1	8.26 ± 0.00	17	8.43 ± 1.71	14	9.10 ± 1.48	10	9.81 ± 1.45	.179 ^b
14	1	8.25 ± 0.00	9	7.78 ± 0.62	2	10.48 ± 2.53			.026 ^b
Total	60 (4.1%)	8.20 ± 1.56	940 (63.7%)	8.15 ± 1.51	241 (16.3%)	8.32 ± 1.43	235 (15.9%)	8.88 ± 1.58	

Abbreviations: ANOVA, analyses of variance; BMI, body mass index; SD, standard deviation; TFTS-N, Timed Floor to Stand-Natural.

^aGroups with significant differences at $P < .05$.^bPost hoc tests not performed with one group having fewer than 2 cases.

whereas those 12 to 14 years old have ranges of 5- to 8-second differences. This reflects greater variability across trials, confirmed by the lower correlations in the younger children (Table 3). These findings may also reflect differences in cognitive processing as younger children may focus differently on the rules for completing the task than do older children.¹³

The very small difference of 0.17 seconds between trials 1 and 2 is not functionally important, as it is less than 1 second. This finding does reinforce the results of a prior study of test-retest reliability¹ with a much larger, culturally diverse sample of urban school children. If a PT is short on time or a student has difficulty with the task, 1 trial would most likely be sufficient for obtaining a functionally useful baseline time on the TFTS-N when the testing procedures and criteria are met, especially in older children. Likewise, although a few differences were found between children whose BMI falls into the healthy category versus the obese category, the overall differences are approximately 1 second, and this is not functionally relevant in the school setting.

TFTS-N Versus TFTS

The average times on the TFTS-N were 1.31 to 2.38 seconds slower than those reported by Haley et al.⁴ The difference in results can be attributed to the modification of the test instructions from “walk as fast as you can”⁴ to “walk, don’t run”¹ and modification of timing procedures from when movement to rise from the floor was initiated⁴ to starting the time on the verbal cue of “go.”¹ The latter approach takes into account the child’s processing time from hearing the instruction through completion of the task. It is important to note that a difference of 1.31 to 2.38 seconds is not functionally meaningful in typical classroom floor to stand transitions.

Utility of the TFTS-N

The TFTS-N is a standardized test that measures the efficiency of floor to stand transfers within the home and school environment. It has established reliability¹ and this study provides reference data for a larger, diverse urban sample of school children, broken down by age, sex, and BMI. The TFTS-N is a useful test for school-based PTs because it simulates the functional task of transitioning to and from the floor, which occurs multiple times a day. When a teacher reports concerns about a student’s ability to transition efficiently during circle time or within other school settings, the TFTS-N may be appropriate to determine how 1 student’s speed compares to other age-matched children with TD. The TFTS-N provides a reference to use for students with disabilities who are placed in regular classrooms, and may provide a reasonable target range for setting goals. The standard deviations are less than 2 seconds for all age groups; therefore, even a student who transitions within 2 standard deviations, or 4 seconds of the reference value, may well be functionally performing within an acceptable range for school or classroom transitions.

Therapists should use the TFTS-N in conjunction with other examination and evaluation results to determine a need for physical therapy services and to set goals for an IEP. In addition, when the TFTS-N testing procedures are used repeatedly (eg, monthly and quarterly), PTs can use the results to monitor student progress or assess the efficacy of treatment interventions directed at transitions from and to the floor.

Limitations

Data collection for the TFTS-N was conducted in a relatively empty school gym or hallway area designated for testing. Although this is typical for testing, the actual task is most commonly performed in a classroom where there are numerous environmental factors that might

affect student performance (ie, background noise, proximity of other students and furniture, lighting, and floor rugs). Students are often asked to perform a series of tasks with a transition, such as retrieve a book from a shelf, or write something on a board, before returning to sitting on the floor. These factors are not represented in the TFTS-N values. Including observations of a student's actual performance in the school environment, in conjunction with the TFTS-N scores, is important to determine the factors that contribute to a child's challenges with transitions. Children with atypical development were not included in this sample. Additional testing of children with atypical development, with specific disabilities or with cognitive challenges, may be advantageous, with the aim of expanding the use of the TFTS-N for all children.

CONCLUSIONS

This cross-sectional study is the first to provide reference data for the TFTS-N test. The data represent a large, urban cohort of ethnically diverse, children with TD, ages 5 to 14 years. The TFTS-N performance times range from 7.91 ± 1.65 seconds to 8.98 ± 1.62 seconds, with no clinically meaningful differences between males and females, or among the 4 BMI categories as defined by the Centers for Disease Control and Prevention. The TFTS-N is useful in all pediatric settings where children need to be assessed on their transitions to and from the floor. This reference data for children with TD should be used in conjunction with clinical observations and other standardized mobility tests and measures for a comprehensive evaluation.

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