Methods of Standing from Supine and Percentiles for Time to Stand and to Run 10 Meters in Young Children

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Objective To assess the method and time to stand from supine and the time to run 10 m for normal young children.
Study design Three hundred twenty-one normal children aged 2.8-7.8 years were recruited from primary schools. After standardization, each test was carried out twice, timed, and videoed. The influence of age, sex, height, weight, body mass index (BMI), and method of standing were analyzed. Charts for time to stand and running time were produced and assessment of reproducibility performed.
Results For the time to stand from supine and the method used, there was a significant correlation with age. More than 50% of young children took >2 seconds. There was no significant association with BMI. Method of standing was associated with standing time in boys but not in girls. A Bland-Altman plot of standing times by 2 observers showed good reproducibility with no clinically significant difference. For the 10-m running test, there was a significant negative correlation with age, height, weight, and BMI.
Conclusion There is considerable variability in the method used and time taken to stand from supine in young children. These change with age, permitting the creation of charts showing age-related normal values. *(J Pediatr 2013;162:552-6)*.

Detecting and quantifying weakness are important parts of the neurologic examination but are difficult in a young child. In older children with known neuromuscular disorders, objective assessment of strength in specific muscle groups is possible with myometry and Medical Research Council power grading.[1-3] Otherwise, studies have used assessments of muscle function rather than weakness, such as the 6-minute walk test, which is a validated outcome measure for intervention studies.[4-7] These assessments are often complex, may require specialized therapy input, and need a child's understanding and cooperation. As a consequence, they are often too difficult for young children to perform reliably and they are not appropriate as a screening tool for muscle weakness in most routine outpatient consultations.

Standing from the floor and running 10 m are already used as tests in clinical practice.[5,6] Gowers sign is pathognomic of weakness but is dependent on age.[7,8] Dubowitz also used the time to stand as a method to assess muscle strength in children, stating that a normal child should stand in less than 1 second, while a child with Duchenne muscular dystrophy (DMD) invariably takes >2 seconds.[9,10] However, normal values are not available for this or for the time taken to run 10 m.

The aims of our study were to define normal values for the time to stand from supine and the time to run 10 m, to formulate charts for these tests, and to assess their reproducibility. We assessed the influence of sex, age, weight, height, and body mass index (BMI) on standing time, running time, and the methods of standing used.

Methods

Healthy children aged 2-8 years were recruited prospectively from 13 nurseries and primary schools in Sheffield, United Kingdom, with local ethical committee approval. Informed consent was obtained from the parents and children. All children were invited to participate, but data from children with a known diagnosis that affected motor function or who could not follow the instructions were excluded from the study. The children were assessed by a medical student and a neurology trainee. The child's age, sex, height, weight, and ethnicity were recorded.

Each child was asked to lie supine, on a firm nonslip mat, with his or her arms extended by their sides, legs together and extended, and asked to stand as quickly as possible. Each child practiced the maneuver once and was then timed and video recorded standing from supine twice. The time taken to stand from supine was from the initiation of movement until the child was in a vertical standing position with both feet on the mat. The method used to stand from supine was obtained by retrospectively reviewing the video records, and agreeing on mutually exclusive categories. In addition, whether the child put a hand on the knee during standing was noted.

BMI	Body mass index
DMD	Duchenne muscular dystrophy
MRT	Mean time to run 10 m
MST	Mean standing time from supine

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The authors declare no conflicts of interest.

 http://dx.doi.org/10.1016/j.jpeds.2012.08.030

For the 10-m running test, distances at 10 and 12 m were marked with chalk on a flat ground. The child was asked to run as fast as possible over the entire 12-m distance, but the time until the second foot passed 10 m was recorded. The additional 2 m were used to avoid the child slowing down before the end of the timed distance.

ANOVA and χ^2 statistical analysis of the data were used. Logistic regression of the root transform was used to formulate percentile charts. To test reproducibility, 2 independent observers reviewed random samples of 44 children's standing from supine videos. Each observer assessed the method of standing according to categories and recorded the standing from supine times. Each observer was blinded to the other observers' findings. A Bland-Altman graph was plotted to assess the reproducibility. We were unable to assess reproducibility for the 10-m running times as the video recordings were not detailed enough. The videos of running were filmed pragmatically, with the majority of children running toward the camera rather than being filmed at a 90° angle showing starting and 10-m finish line.

Results

Three hundred twenty-one children (161 boys, 160 girls) were recruited: 3 aged <3, 64 aged 3-4, 75 aged 4-5, 85 aged 5-6, 79 aged 6-7, and 15 aged 7-8 years (mean 5.1 years, range, 2.8-7.8). Two were excluded because of the diagnosis of hemiplegia and Down syndrome, and an additional 2 refused. Two hundred eighty-five were white British (88.8%). Their BMI ranged from 10.6 to 21.9 kg/m^2 (mean 15.9 kg/m^2).

The mean standing time from supine (MST) was 2.08 seconds (range 1.03-5.28 seconds). There was no statistically significant difference between the 2 standing times recorded. There was no significant difference between boys and girls for MST (boys 2.03 ± 0.7, girls 2.11 ± 0.69, $P = .32$). There was no correlation between MST and BMI (boys, $P = .24$; girls, $P = .60$). However, there was a significant negative correlation between MST and age in both sexes (boys $r = -0.53$ [95% CI = −0.63 to −0.41], $P \leq .0001$; girls $r = -0.5$ [95% CI = −0.61 to −0.37], $P \leq .001$). Charts with percentiles are presented in Figure 1.

The children used a range of different methods to stand. From observation these could be divided into 6 categories as follows: (1) Sits up, then stands: Forward flexion of trunk to sitting position (90° flexion) and stands up. Hands may be placed on floor at either side of the pelvis, and used to push up from floor; (2) Flexes and turns trunk <45°, then stands: Forward flexion of the trunk to 60° and rotates the trunk <45°. Upper limb(s) placed on the floor behind trunk and pelvis and used to push up from floor; (3) Flexes and turns trunk >45°, then stands: Forward flexion of the trunk to 60° and rotates the trunk >45°. Upper limb(s) placed on the ground behind trunk and pelvis and used to push up from floor; (4) Rolls to prone before standing: From supine rotates 180° to prone and uses upper limbs to push up from floor to stand; (5) Sits up, then moves forward onto "all fours," then stands: Truncal flexion into sitting position (90°) and further forward flexion onto all 4 limbs and then stands up; (6) Flexes, turns trunk >45°, moves onto all 4 limbs, then stands: Forward flexion of the trunk to 60° to the vertical, and twists the trunk >45° with one upper limb crossing the trunk. Upper limbs are placed on the ipsilateral side of trunk to push up from the floor followed by further truncal rotation onto all 4 limbs before standing.

The correlation between the methods of standing and age are summarized in the Table.

Two hundred seventy-eight (86.6%) children used method 1, 2, or 3 to stand from a sitting position, whereas only 42 (13%) used the last 3 methods, 4, 5, or 6, to stand from prone or all 4s. Children aged >6 years always stood from a sitting position (methods 1-3).

Only 9 (2.8%: 4 girls, 5 boys) children rolled directly to prone: they had a mean age of 3.8 years (range 3-5). In addition, 39 (12.9%) children put one hand on the

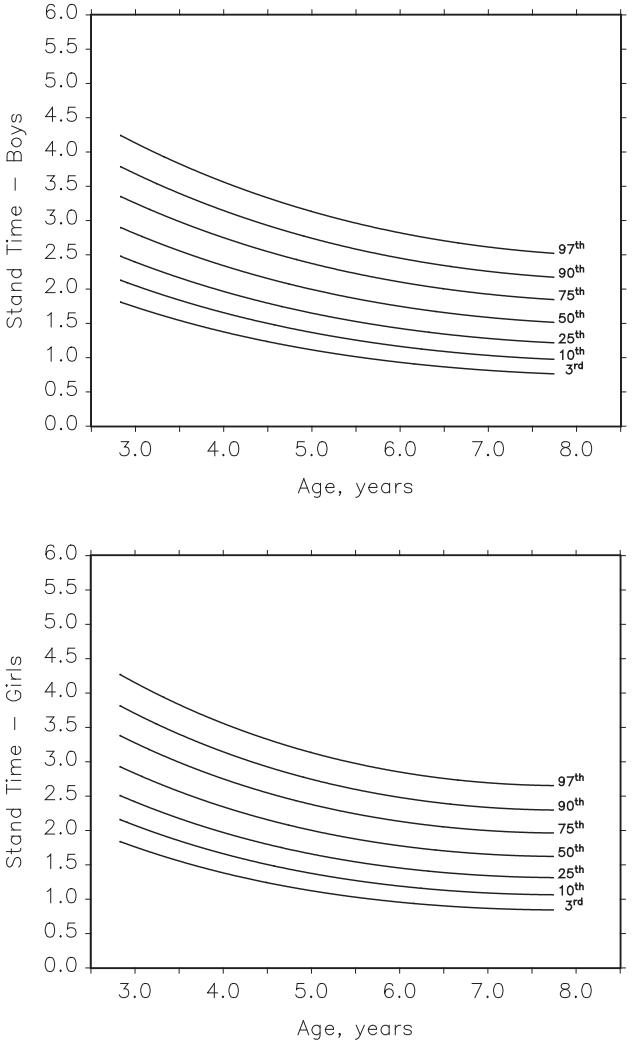

Figure 1. Percentile charts for normal values of standing from supine position (boys/girls). *Lines* represent the percentiles.