Short communication

Reference data for performances on the standardized walking obstacle course in children developing typically

Karen M. Kott, PT, PhD[a,*], Sharon Held, PT, DPT, MS, PCS, C/NDT[b],
Mary Rose Franjoine, PT, DPT, MS, PCS, C/NDT[b]

[a] Old Dominion University, School of Physical Therapy and Athletic Training, 3118 Health Sciences Building, Norfolk, VA 23529, United States
[b] Daemen College, Physical Therapy Program, 4380 Main Street, Amherst, NY 14226, United States

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ABSTRACT

Purpose: To establish reference performance groups on the Standardized Walking Obstacle Course (SWOC) a pathway to screen ambulation for children developing typically.
Methods: SWOC tests ambulation under three conditions: walk (W), walk with tray (WT) and walk wearing sunglasses (WG). One trial consisted of standing up, walking the course in one direction and sitting down. Children (n = 355) completed two trials per condition. Trial measures included time to complete (seconds) and numbers of steps, stumbles, and steps off path.
Results: Trial 1 and trial 2 for time and number of steps are significantly different (p = 0.0005), but highly correlated (r = 0.93 and r = 0.96) therefore their average was used to establish reference data. Gender was not a significant factor. Age and height predict performances in all conditions, but measures between age groups were not always significantly different. Significant different measures by height groups could be established across all conditions, therefore reference data was established using three height groups.
Conclusion: Reference values will assist clinicians to compare a child's performance on the SWOC based on an individual height because this can vary within and between ages thus screening for possible ambulation limitations.

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1. Introduction

Sophisticated tools such as electronic walkways [1] provide accurate time and distance parameters of gait. A limitation of these tools is not accounting for environmental factors that may impact ambulation. Community ambulation requires adequate temporal-spatial factors, such as covering a given distance in a certain amount of time, making postural transitions stepping around obstacles, and negotiating different surfaces often while carrying loads in two hands or with limited lighting [2]. Consideration of environmental demands to examine and plan treatment in children is encouraged by the International Classification of Function, Disability and Health Model [2,3]. The Standardized Walking Obstacle Course (SWOC) [4] was developed to measure ambulation taking into consideration the factors noted above.

SWOC has excellent inter-rater reliability for the performance measures of time intraclass correlation coefficient (ICC) 0.99 and number of steps 0.94–0.99 in children [4,5]. It has demonstrated validity in screening limitations in ambulation [5], but further clinical use measuring change over time would be enhanced if reference data were available. The purpose of this study was to establish reference data for performances on the conditions of the SWOC for children developing typically.

2. Methods

2.1. Participants

Children recruited from schools formed a sample of convenience. Inclusion criteria were children with no known gait or cardiopulmonary pathologies, no cognitive limitations hindering ability to follow three-stage directions and no physical limitations to carrying an object with two hands. Prior to data collection, parent/guardian provided informed consent and children provided assent. This research was approved by the Human Subjects Research Review committees at three Colleges/Universities.

* Corresponding author.
  E-mail address: kkott@odu.edu (K.M. Kott).

2.2. Instrumentation

The SWOC [4] pathway is 39.5 feet long and 36 inches wide with turns of 30° right, 70° left, and 90° right, and includes stepping over a crutch which spans the path's width, walking across a brightly colored rug for visual stimulation and a shag rug for change in floor texture, stepping around a garbage can, and transitioning from sit to stand or stand to sit at either end of the path. (Fig. 1). The task is to walk remaining on the path despite obstacles and changes in surface or direction. It is standardized in its components, their placements, and directions for measurements; placing the sources of variability on the participants' measures and not on the instrument [6].

The conditions of the SWOC are: walk with hands free (W), walk with tray (WT), and walk with sunglasses (WG). The tray provides a light load (plastic place setting) to carry in two hands and blocks the view of the feet. The sunglasses create a dimly lit environment, challenging vision [4,5].

2.3. Procedures

The participants reported to various testing locations i.e. school gymnasiums on one occasion testing taking approximately 10 min. All examiners followed standardized procedures previously established [4].

Before testing, age and gender were recorded and height was measured using a tape measure placed on a wall and a ruler against the top of the head. All children wore usual school/play attire and footwear.

Participants randomly assigned to begin under one of three conditions: (W), (WT) or (WG), received verbal instructions to walk at their usual home or school speed, a demonstration, and practiced one trial of W and WT to understand the differences between these tasks [4].

One SWOC trial consisted of standing up, walking the course in one direction, and sitting down. A trial began when the child initiated standing by lifting the buttocks off the chair and concluded with sitting in the chair at the other end. After resting as needed, the second trial was walking in the opposite direction,

and subsequently a new condition began. A total of six trials (2 per condition) were completed. Data collected were time (digital stopwatch) to complete one trial, and counts of the numbers of steps, stumbles (any loss of balance or contact with an obstacle) and steps off (all or part of the foot touching the floor off the path) during that trial. The stumbles and steps off demonstrate postural instability to environmental demands.

2.4. Data analyses

Paired-t tests and correlations determined the relationship between trial 1 and trial 2. Regression analyses determined the relationship of the factors of gender, age, and height to the SWOC measurements. Alpha was set a prior ($p < 0.05$). Descriptive statistics determined means and standard deviations for all measures, and reference intervals, and coefficients of variation for the measures of time and number of steps under each condition. Cadence and velocity were then calculated. All statistical tests were completed using SPSS version 21.0 [7].

3. Results

3.1. Participants

A total of 355 typically developing children aged 3–15 years participated. Gender was not a significant factor ($p > 0.05$). Age and height significantly predict mean number of steps $F_{(2,349)} = 296.23$, $p = 0.0001$, $R^2 = 0.63$ and mean time $F_{(2,349)} = 74.09$, $p = 0.0001$, $R^2 = 0.30$ in all conditions. Height carried the most weight in the predictive model ($B = 0.37$). Age did not always establish significant between group differences. Therefore, reference data are reported by three height groups for significant between group changes in data described in Table 1.

3.2. Reference data by conditions of the SWOC

Trial 1 and trial 2 differed significantly for time ($p = 0.0001$) and number of steps ($p = 0.001$) but are highly correlated ($r = 0.93$ and $r = 0.96$ respectively), therefore average of the trials was used.
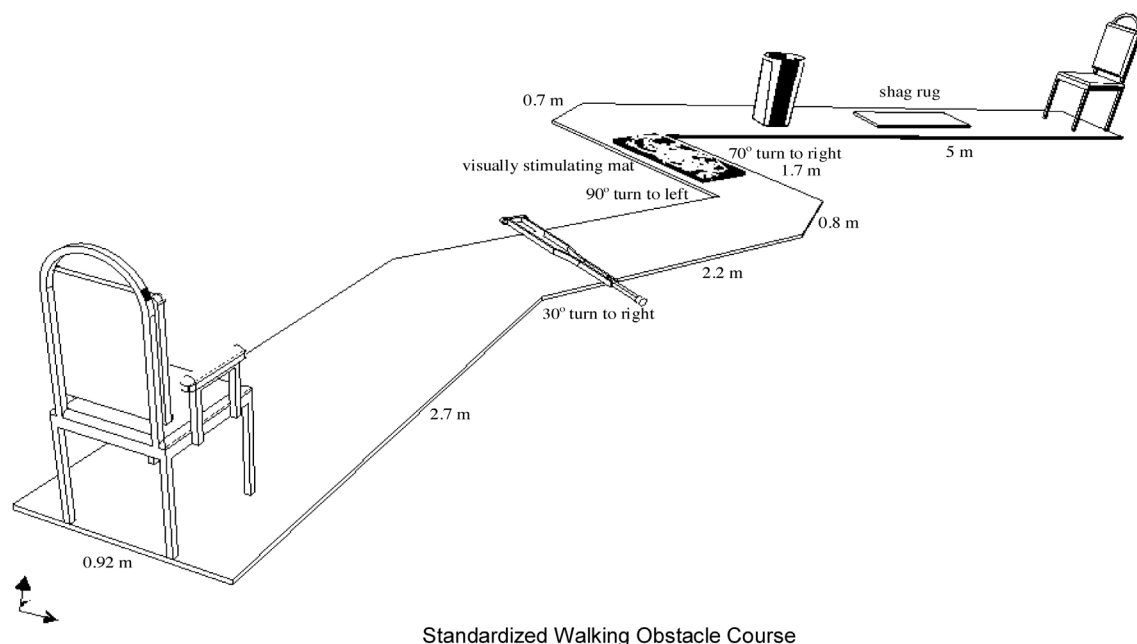

Standardized Walking Obstacle Course

Fig. 1. Standardized Walking Obstacle Course.