Clinician's Commentary on Hayes et al.¹

Cardiorespiratory endurance is an important component of health-related fitness.² Physiotherapists may, therefore, want to evaluate cardiorespiratory endurance in their clients who have, or who are at risk for, impairment in this area. Maximum, or peak, oxygen uptake during a graded exercise test typically quantifies cardiorespiratory endurance. This type of direct measurement of cardiorespiratory endurance, however, requires specialized equipment to analyze the expired gases. Because such equipment may not be available in a physiotherapy clinic, tests that estimate cardiorespiratory endurance without expired gas analysis, referred to as *clinical tests* or *field tests*, may be more feasible for physiotherapists to use.

Hayes and colleagues¹ were interested in clinical cardiorespiratory endurance tests appropriate for younger school-aged children aged 5–10 years. They developed and evaluated some of the measurement properties of a new submaximal step test, the Step Test of Endurance for Pediatrics (STEP). This test uses a set of three wooden steps, 0.1, 0.2, and 0.3 metres high. Beginning with the lowest step, children step up and down at 22 steps per minute (following a metronome) for 2 minutes, with a 10-second break between steps (stages), during which time their heart rate is measured by means of auscultation. The test score is the heart rate, in beats per minute, during the 10 seconds after each 2-minute stage and the average of these three end-stage heart rates.

The researchers recruited 170 children aged 5–10 years who had no contraindications to exercise testing, although some of them had comorbidities (attention deficit disorder, asthma, heart murmur, environmental allergies). The children performed the STEP twice, followed by a graded exercise test to exhaustion on a treadmill, during which time their expired gases were analysed. There was a 15-minute break between each test. The authors report high test–retest within-session reliability of the various heart rate results (intra-class correlation coefficients < 0.90). However, in their opinion, many of the children aged 5 and 6 years did not appear to be able to reach an adequate level of exertion during the STEP; as a result, they were not able to validate the test for this age group. For the group aged 7–10 years, who had an adequate result for the graded exercise test on the treadmill (111 of 125 children of both sexes), the average STEP heart rate and BMI accounted for about half the variance in maximal oxygen uptake.

The study illustrates some of the challenges in developing a new paediatric cardiorespiratory endurance test for clinical practice. The test may not be feasible for some clinicians to use because it requires steps of three specific heights. Given that the test may not be feasible for children aged 5–6 years, a test requiring less motor control, or a smaller difference in the level of exertion between the stages, may be needed for them and perhaps for some clients with motor impairment. Performing all tests in a single session may also have been fatiguing for the children in the study, even if their heart rate recovered between the tests. The maximum oxygen uptake values in the study, for example, are on the lower end of what is typically seen for children without motor impairment.³

The study protocol cannot rule out the fact that fatigue might have influenced test performance, especially on the graded exercise test on the treadmill, the third test performed. The use of

auscultation to measure heart rate at the end of each stage was also curious. Even in very young children, and despite the reliability issues, it is usually measured using a heart rate monitor, and it is usually measured during the exercise⁴ to avoid the possibility that heart rate recovery might influence the results.

Information about the test–retest between-session reliability and about the minimal detectable change would also help clinicians who want to use the test to make decisions about the effects of an intervention or about change over time. Also, more information about the error associated with the maximum oxygen uptake prediction and an independent validation of the algorithm would help test users interpret the maximum oxygen uptake predictions. Finally, future studies may want to evaluate the measurement properties of the STEP with the various clinical populations appropriate for the test, because this information would also help physiotherapists interpret test results.

In conclusion, Hayes and colleagues¹ have provided some preliminary evidence about the reliability and validity of the STEP. Physiotherapists interested in knowing more about available paediatric cardiorespiratory endurance tests may want to follow the guidelines in the COnsensus-based Standards for the selection of health Measurement INstruments.⁵ These guidelines recommend that clinicians consult systematic reviews of the measurement properties of tests, which evaluate, for the population of interest, the construct of interest (in this case, cardiorespiratory endurance). Another recommended strategy, if systematic reviews are not available, is to refer to individual articles that have evaluated the measurement properties of the test with the population of interest.

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