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1. Krishnan-Sarin S, Jackson A, Morean M, et al. E-cigarette devices used by high-school youth. *Drug Alcohol Depend.* 2019;194:395-400. doi:10.1016/j.drugalcdep.2018.10.022
2. Huang J, Duan Z, Kwok J, et al. Vaping versus JUULing: how the extraordinary growth and marketing of JUUL transformed the US retail e-cigarette market. *Tob Control.* 2019;28(2):146-151. doi:10.1136/tobaccocontrol-2018-054382
3. Allem JP, Dharmapuri L, Unger JB, Cruz TB. Characterizing JUUL-related posts on Twitter. *Drug Alcohol Depend.* 2018;190:1-5. doi:10.1016/j.drugalcdep.2018.05.018
4. Jackler RK, Chau C, Getachew BD, et al. JUUL advertising over its first three years on the market. http://tobacco.stanford.edu/tobacco_main/publications/JUUL_Marketing_Stanford.pdf. Published January 31, 2019. Accessed February 7, 2019.
5. Farrelly MC, Duke JC, Crankshaw EC, et al. A Randomized trial of the effect of e-cigarette TV advertisements on intentions to use e-cigarettes. *Am J Prev Med.* 2015;49(5):686-693. doi:10.1016/j.amepre.2015.05.010
6. Morgan-Lopez AA, Kim AE, Chew RF, Ruddle P. Predicting age groups of Twitter users based on language and metadata features. *PLoS One.* 2017;12(8):e0183537. doi:10.1371/journal.pone.0183537

Assessment of Validity and Reliability of the 1-Minute Sit-to-Stand Test to Measure the Heart Rate Response to Exercise in Healthy Children

The importance of physical activity is gaining recognition in children with cardiac or respiratory diseases, and the measurement of heart rate (HR) response during exercise is required.¹ The 6-minute walking test (6MWT), which has been verified for validity and reliability in children,² is the reference field test to measure functional exercise capacity. New field tests are emerging to counteract the practical drawbacks associated with the 6MWT. The 1-minute sit-to-stand test (STST) is easy to implement and has already been validated in adults,³ but not yet in children. Moreover, to our knowledge, the physiological response associated with this test is unknown in children. The aims of this study were to evaluate the concurrent validity and reliability of the STST in measuring the HR response to submaximal exercise and functional exercise capacity in children.

Methods | After ethical approval from the Comité d’Ethique hospitalo-facultaire at Cliniques universitaires St-Luc, registration (NCT03670511), and written informed consent were provided, healthy children aged 8 to 18 years were recruited. The only inclusion criterion was participation in the mandatory medical investigation at school. The exclusion criteria were a diagnosis of chronic lung, cardiac, or neuromuscular disease, motor disability, or being overweight.

Children performed 2 1-minute STSTs⁴ (STST1 and STST2) with a 1-week interval. Concomitantly to STST1, children performed a 6MWT as a reference test.² The number of sit-to-stands, walked distance, HR, and HR response (Δ HR initial to final [i-f] and Δ HR final to rest [f-r]) during the test were recorded. The STST concurrent validity (association with the 6MWT), inter-STST agreement (Cohen κ), reliability (intra-class correlation coefficient [ICC]), and repeatability (paired *t* test after checking for normality [learning effect] and the Bland-Altman method) were verified. Statistical analyses were performed with SPSS, version 25.0 (IMB) and statistical significance was set at $P < .05$.

Results | Fifty-two children (mean [SD] age, 12.8 [2.4] years) were recruited. All children completed the tests.

Concurrent Validity. The HR and HR responses were similar for both tests (Table 1). However, HR recovery (Δ HR_{f-r}) was faster for the STST than for the 6MWT. The HR_f was lower than the theoretical maximal HR for all children and tests (STST1, 70%; 95% CI, 67-73 and 6MWT, 69%; 95% CI, 65-72).

The HR changes (Δ HR_{i-f}) in the STST1 and the 6MWT were moderately and significantly associated with one another ($\rho = 0.522$; $P < .001$). The distance was not associated with the number of sit-to-stands ($\rho = 0.178$; $P = .21$) (Table 1). No anthropometric parameter was associated with the number of sit-to-stands, unlike age ($\rho = 0.294$; $P = .03$).

Reliability and Repeatability. The inter-STST agreement regarding the HR response was weak but statistically significant ($\kappa = 0.24$; $P = .006$). The reliability (ICC) of the HR response (Δ HR_{i-f} and Δ HR_{f-r}) was verified without a learning effect (*t* test) (Table 2). The bias was -5% (95% CI, -12 to 2) and the limits of agreement were -55% (lower) and 44% (upper).

Table 1. Concurrent Validity of the Functional Exercise Capacity and the HR Responses Measured by the STST and the 6MWT in Children^a

Measure	Mean (SD)		Difference Between STST1 and 6MWT	Difference (95% CI)	P Value	ρ	P Value
	6MWT	STST1					
Distance, m/STS	646 (55)	40 (6)	NA	...	...	0.178	.21
HR _i , bpm	92 (15)	94 (15)	-2 (10)	(-4 to 1)	.18	0.785	<.001
HR _f , bpm	139 (24)	141 (20)	-2 (17)	(-7 to 3)	.38	0.698	<.001
Δ HR _{i-f} , %	51 (24)	51 (22)	-0.3 (23.8)	(-6.9 to 6.3)	.93	0.522	<.001
Δ HR _{f-r} , %	19 (8)	22 (9)	-3.5 (8.7)	(-5.8 to -1.1)	.006	-0.298	.03

Abbreviations: 6MWT, 6-minute walking test; bpm, beats per minute; f, final; HR, heart rate; Δ HR_{f-r}, HR recovery; Δ HR_{i-f}, HR change; i, initial; NA, not applicable; r, rest (2' posteffort); STS, sit-to-stand; STST, sit-to-stand test.

^a Data are expressed as mean (SD).

Table 2. Repeatability and Reliability of the Functional Exercise Capacity and the HR Responses Measured by 2 STSTs in Children^a

Measure	Mean (SD)		Repeatability			Reliability		
	STST1	STST2	Difference Between STST1 and STST2, Mean (SD)	Difference, 95% CI	P Value	ICC, STST1 and STST 2	Difference, 95% CI	P Value
Distance, m/STS	40 (6)	42 (6)	2 (4)	1 to 4	<.001	0.90	0.832-0.945	<.001
HR _i , bpm	94 (15)	92 (15)	-2 (11)	-5.4 to 0.9	.16	0.83	0.708-0.903	<.001
HR _f , bpm	141 (20)	142 (21)	1 (17)	-3.9 to 5.7	.71	0.78	0.622-0.875	<.001
ΔHR _{i-f} , %	51 (22)	56 (28)	5.2 (25.2)	1.8 to 12	.14	0.68	0.434-0.814	<.001
ΔHR _{f-r} , %	22 (9)	25 (11)	2.4 (10.3)	-0.4 to 5.3	.10	0.66	0.413-0.807	<.001

Abbreviations: bpm, beats per minute; f, final; HR, heart rate; ΔHR_{f-r}, HR recovery; ΔHR_{i-f}, HR change; i, initial; ICC, intraclass coefficient; r, rest (2' posteffort); STST, sit-to-stand test.

^a Data are expressed as mean (SD).

The reliability (ICC) of the number of sit-to-stands was excellent, but a learning effect (*t* test) was observed (Table 2). The number of repetitions was greater in STST2 than in STST1 in 43 patients (83%). The repeatability of the number of sit-to-stands was verified with a bias of 2.5 (95% CI, 1.5-3.5) and limits of agreement of -4.9% (lower) and 9.9% (upper).

Discussion | To our knowledge, this study demonstrated for the first time the concurrent validity and reliability of the STST to quantify the HR response during submaximal exercise in healthy children. Indeed, the cardiorespiratory responses to the STST and the 6MWT were similar and associated in the sample of healthy children. This result means that the STST is a good alternative field test to the 6MWT to evaluate cardiorespiratory demand. The STST is interesting because its submaximal exercise is similar to the 6MWT, but it is less time-consuming while also requiring fewer resources and no long hallway.

Moreover, the reliability of the cardiorespiratory response measured by the STST at a 1-week interval was verified. Although we cannot consider the STST as a surrogate for the 6MWT for measuring the functional exercise capacity in children because of the lack of association with the walked distance, the STST was reliable for the number of repetitions measurement. The associated learning effect observed for the number of sit-to-stands, which contrasted with the adult results, could be explained by the differences in intrinsic motivation⁵ and time perception⁶ between adults and children. The STST could be used complementarily with the maximum incremental cardiopulmonary exercise test or when that test cannot be performed.

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1. Brubaker PH, Kitzman DW. Chronotropic incompetence: causes, consequences, and management. *Circulation*. 2011;123(9):1010-1020. doi:10.1161/CIRCULATIONAHA.110.940577

2. Li AM, Yin J, Yu CC, et al. The six-minute walk test in healthy children: reliability and validity. *Eur Respir J*. 2005;25(6):1057-1060. doi:10.1183/09031936.05.00134904

3. Bisca GW, Morita AA, Hernandez NA, Probst VS, Pitta F. Simple lower limb functional tests in patients with chronic obstructive pulmonary disease: a systematic review. *Arch Phys Med Rehabil*. 2015;96(12):2221-2230. doi:10.1016/j.apmr.2015.07.017

4. Ozalevi S, Ozden A, Itil O, Akkoclu A. Comparison of the sit-to-stand test with 6 min walk test in patients with chronic obstructive pulmonary disease. *Respir Med*. 2007;101(2):286-293. doi:10.1016/j.rmed.2006.05.007

5. Gillet N, Vallerand RJ, Laferrière M-AK. Intrinsic and extrinsic school motivation as a function of age: the mediating role of autonomy support. *Soc Psychol Educ*. 2012;15:77-95. doi:10.1007/s11218-011-9170-2

6. Gibbon J, Church RM, Meck WH. Scalar timing in memory. *Ann N Y Acad Sci*. 1984;423:52-77. doi:10.1111/j.1749-6632.1984.tb23417.x

Electronic Cigarette Use in US Households With Children: The "New" Secondhand Smoke

Electronic cigarette (e-cigarette) aerosols are widely perceived as safe to nonusers.¹ However, these aerosols contain potentially harmful compounds, including nicotine, volatile organic compounds, heavy metals, and ultrafine particulates,² that nonusers can be exposed to through inhalation, ingestion, or dermal contact with aerosols exhaled into the environment. The US Office of the Surgeon General has recommended prohibiting e-cigarette use in enclosed