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Review Article

SIX MINUTE WALK TEST (6MWT) IN VARIOUS PEDIATRIC CONDITIONS: A LITERATURE REVIEW

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ABSTRACT

The Six Minute Walk Test (6MWT) was developed in 1963 by Balke to evaluate functional capacity. The test was developed in frail elderly patients 60-90 years of age referred to a geriatric hospital, and it targets community dwelling frail elders. However, the test has been used in a variety of chronic diseases, in adult and pediatric populations as well as in healthy adults and healthy pediatric population. It is a common outcome measurement tool used in physical therapy to determine ones basic exercise endurance and functional fitness. It is simple to perform, and it can help the physical therapist evaluate improvement or decline in one's overall functional status during his/her rehabilitation program. It is a self paced sub maximal exercise test used to assess functional exercise capacity in patients with chronic diseases. The test has been used as an estimate of physical fitness in severe cardiopulmonary diseases, cystic fibrosis, juvenile idiopathic arthritis, etc in pediatric population. Knowledge about its measurement properties is needed to determine whether it is an appropriate test to use in paediatric population. The purpose of this study will be to systematically review all published clinimetric studies on the 6MWT in various pediatric conditions.

KEY WORDS: Six Minute Walk Test, Review, Pediatric conditions

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INTRODUCTION

Fitness is a set of physical attributes related to a person's ability to perform physical activity successfully, without undue strain and with a margin of safety [1]. Participating in physical activity is beneficial to people of all ages. Physical activity contributes to fitness, a state in which people's health characteristics and behaviors enhance the quality of their lives [1]. Measurement of physical fitness in children and youth has long been a topic of interest to physical educators, exercise scientists, health agencies, and private organizations dealing with sport and fitness [2].

Various tests have been used to assess fitness. These are the Modified Bruce Treadmill Test, 12-Minute Run Test, 20-Meter Shuttle Test, etc. [3] the 6MWT is one such test used to assess fitness and cardiovascular endurance. 6MWT was developed in 1963 by Balke to evaluate functional capacity. The test was developed in frail elderly patients 60-90 years of age referred to a geriatric hospital and it targets community dwelling frail elders. Purpose of the 6 Minute Walk Test (6MWT) is to test exercise tolerance

in chronic respiratory disease and heart failure. However, the test has been useful in variety of chronic disease in adult and pediatric population as well as in healthy adults [4].

The test has been used in various diseases such as Alzheimer's, children fibromyalgia, geriatrics, heart failure, Multiple Sclerosis, Parkinson's disease, pulmonary disease, Osteoarthritis, spinal cord disease and Stroke. It assesses the distance walked in 6 minutes as a sub maximal test of aerobic capacity/ endurance. Its domain being motor, it does not require training nor any cost. The test age ranges from pre-school children ageing 2-5 yrs to elderly adults 65 plus [5].

The test is simple to perform. The person simply walks at a comfortable pace for a total of 6 mins. He may use a assistive device like a cane or a walker. He is also allowed to rest between the tests if needed. The total distance that the person walks during the 6 MWT is his score. If he is unable to complete the time period, the score becomes the distance walked and the time is also recorded. It can be administered anywhere. Often in hospitals, physical therapy settings, but can also be performed in outpatient clinic [6].

The test is widely being utilized in pediatric population. It has been used as an estimate of physical fitness in, for example; children with severe cardiopulmonary disease, Cystic Fibrosis and Juvenile idiopathic arthritis, etc [7]. There have been some studies of the 6 minute walk as a test of exercise or aerobic capacity in children (either who were considered healthy or those with varying chronic conditions) [8-11]. Age, height, and weight are often factors that affect 6 minute walk times [8-11]. Reliability estimates (ICC) in children range from Â 0.96 - 0.98 and minimal clinically important differences are highly variable and likely depend heavily on the type of chronic condition [12]. Among children with juvenile idiopathic arthritis (JIA), the 6 minute walk was associated with sub maximal levels of exercise intensity suggesting it is a good measure of functional capacity [11]. Recently the 6MWT has been used as an outcome measure in weight loss studies and may be a practical and promising assessment tool for exercise performance in the obese pediatric population [13,14].

Most daily activities are performed at sub maximal levels of exertion and, therefore, it has been proposed that sub maximal functional tests are a better reflection of physical capability [15]. A recent review of functional walking tests concluded that the 6-min walk test (6MWT) is easier to carry out, more acceptable and provides a better reflection of activities of daily living than other walk tests [15]. The test has been used in PFT labs, Pediatrics, Cardiology, Cardiac and Pulmonary Rehab, Primary Care, (Pulmonary, Cardiologist, Pediatricians, COPD), Clinical Trials, Allied health education, PT, Nursing [16]. Because the test reflects an exercise level close to that of daily life activities, it is easy to administer, is well tolerated by patients, and is increasingly being used as a functional outcome measure for people with chronic conditions, including pediatric populations [17]. For example, the 6MWT has been utilized as a functional outcome measure in recent intervention studies including children with mucopolysaccharidosis type 1 [17,18], Duchene muscular dystrophy [17,19], spina bifida, [17-20] and obesity [17,21].

Knowledge on the reproducibility and validity in relation to the 6MWT will enable the clinician to determine in which pediatric conditions and for what purpose the 6MWT is appropriate to use in his or her daily physical therapist practice [17].

Procedure: A literature search was performed using CINAHL, PEDro and Google Scholar. Additional searches were performed using the internet where the used phrases were '6MWT' or '6MWT in paediatric conditions' in full-text and conditions like 'asthma', 'cerebral palsy', etc in paediatric population in the title abstract keyword section. Reference lists of papers identified were read to identify additional papers. Additional information was gathered through authors, teachers, and study sponsors. Articles and research work appearing on the above searches from august 2013 up to December 2013 were included. The articles were studied for 6MWT procedure with reference to ATS guidelines. Those fulfilling ATS guidelines were selected and included for further analysis (Table No. 1). Articles were assessed on the basis of PRISMA guidelines and analysis for the review was done.

Table 1: Six-Minute Walk Test Procedures Compared With American Thoracic Society (ATS) Guidelines.

Study	Location		Instructions				Encouragement	
	Straight Straight Corridor	Length Walking Course [m]	Pretesting Resting Period	Walk As Far As Possible Without Jogging or Running	Turning Around the Cones	Practice Test	Standardized	Phrases in ATS Guidelines
Annelies Hartman et al[22]	Yes	10	No	yes	Yes	No	Yes	Yes
ATS guidelines[23]	Yes	30	Yes	Yes	Yes	Optional	Yes	Yes
Cunha et al[24]	Yes	28	No	yes	No	No	No	No
Elloumi et al[14]	Yes	30	Yes	yes	No	No	Yes	Yes
Gulmans et al[25]	Yes	8	No	yes	No	Yes	Yes	No
Hassan yukseli[26]	yes	20	Yes	yes	No	No	Yes	No
Maher et al[27]	Yes	10	Yes	yes	Yes	No	Yes	Yes
Makni et al[28]	Yes	30	Yes	yes	Yes	No	Yes	Yes
Mandrusiak et al[29]	Yes	30	Yes	yes	Yes	No	No	No
Mazzone et al[30]	Yes	30	Yes	yes	Yes	no	No	No
McDonald et al[31]	Yes	25	Yes	yes	Yes	no	Yes	No
Moalla et al[32]	Yes	30	Yes	yes	No	no	Yes	No
Morinder et al[33]	Yes	70	No	yes	No	no	No	No
Otto et al[34]	yes	8	No	yes	No	no	Yes	No
Paap et al[11]	Yes	8	No	yes	No	no	Yes	No
Thompson et al[35]	No	20x45	Yes	yes	No	no	Yes	No
Yvonne B. et al[36]	yes	8	No	yes	Yes	no	No	No

Table 2: Best evidence syntesi.

	Methodological Quality/Quality Criteria					
Diagnosis	Study	Reliability	Agreement	Hypothesis Testing	Criterion Validity	Responsiveness
Cerebral palsy	Maher et al[27]	Fair/positive	Fair/indeterminate			
	Thompson et al[35]	Excellent/positive	Excellent/indeterminate			
Level of evidence		Strong	Unknown			
Cystic fibrosis	Maristela Trevisan Cunha et al[24]	Good/positive	Fair			
	Gulmans et al[25]	Fair/positive		Fair/positive	Excellent/positive	
	Mandrusiak et al[29]	Fair/positive				
Level of evidence		Moderate		Limited	Limited	
Juvenile idiopathic arthritis	OTTO T. H. M. Et al[34]	Poor				
	Paap et al[11]	Good			Fair/negative	
Level of evidence				Limited	Moderate	
Congenital heart disease	W. Moalla et al[32]	Fair/positive	Fair/indeterminate		Excellent/positive	
Level of evidence			Unknown	Unknown	Limited	
Duchenne muscular Dystrophy	Mcdonald et al[31]	Fair/positive	Fair/indeterminate	Fair/positive		
	Mazzone et al[30]					Fair/positive
Level of evidence		Limited	Unknown	Limited		Limited
Obesity	Ralf Geiger et al[9]	Positive				
	Morinder et a[33]	Good/positive	Good/indeterminate		Fair/negative	
	Makni et al[28]					
	Elloumi et al[14]					
Level of evidence		Moderate	Unknown	Moderate	Limited	
Acute lymphoblastic leukemia	Annelies hartman et al[22]					
Level of evidence		moderate				
Asthma	Hasan YÜKSEL[26]	Good/positive	Good/indeterminate			
	Lívia Barboza de Andrade et al[37]	Good/positive				
Level of evidence		moderate				
Generalized hypermobility	Yvonne b. Hanewinkel-van kleef et al[36]	Fair/positive	Fair/indeterminate			
Level of evidence		limited				

Level of evidence: strong_consistent findings in multiple studies of good methodological quality or in one study of excellent methodological quality, moderate_consistent findings in multiple studies of fair methodological quality or in one study of good methodological quality, limited_one study of fair methodological quality, conflicting_conflicting findings, unknown_only studies of poor methodological quality

RESULTS

Table 3: Summary of the Measurement Properties of the Studies Included for Best Evidence Synthesis: Reliability and Measurement Error.

Study	Population Patients (N) Age (y), X(SD) Sex (M/F) Disease Characteristics	Reliability	Measurement Error 6MWD: LOA (m), SDD (m), SEM (m)
Cunha et al [24]	Cystic fibrosis (N=16) Age: 11.0 (1.9) Sex: 5/11 FEV1 (%), X (SD) [range]: 63.1 (21.1) [30–94]		LoA: _132.7 m to 100.9 m
Gulmans et al [25]	Cystic fibrosis (N=23) Age: 11.1 (2.2) Sex: 12/11 FEV1 (%), X(SD) [range]: 94.4 (16.5) [61–130]	*rp* _.90, *P* _.0001	
Maher et al [27]	Cerebral palsy (N_41) Age: 13.6 (1.6) Sex: 26/15 GMFCS levels: 1–3	ICC_.98	LoA: _44 m to 42.3 m
Mandrusiak et al [29]	Cystic fibrosis (N_16) Age: 13.1 (2.7) Sex: 8/8 FEV1 (%), X (SD) [range]: 65 (18) [36–92]	6MWD: ICC_.93 Borg Scale of Perceived Breathlessness: ICC_.92 15 c (15-count breathlessness score): ICC_.66 SpO2: ICC_.81 Heart rate: ICC_.87	
McDonald et al [31]	DMD (N_21) Age: 8 (median), 5–12 (range) Sex: 21/0 Ambulatory (_10 m without AD)	6MWD: ICC_.91	LoA: _66 m to 74 m
Moalla et al [32]	Congenital heart disease (N_17) Age: 13.5 (0.5) Sex: ? NYHA class 2–3		LoA: _14.2 m to 11.6 m
Morinder et al [33]	Obesity (N_49) Age: 13.2 (?), 8–16 Sex: 30/19 BMI (kg/m2): 33.9 (median), 23.3–57 (range)	ICC_.84	LoA: _65 m to 71 m SEM: 24 m SDC: 68 m
Thompson et al [35]	Cerebral palsy (N_31) Age: 9 (3) Sex: 15/16	ICC_.98 GMFCS level 1(n_9): ICC_.93; GMFCS level 2 (n_8): ICC_.91; GMFCS level 3 (n_13): ICC_.98	LoA: _71.6 to 57 m SEM: 19.8 m SDC: 54.9 m

a FEV1_forced expiration volume in 1 second, GMFCS_Gross Motor Function Classification System, DMD_Duchenne muscular dystrophy, SpO2_oxygen saturation, AD_assistive device, NYHA class_New York Heart Association Classification for heart failure, BMI_body mass index, 6MWD_6-minute walking distance, 6MWT_Six-Minute Walk Test, LoA_limits of agreement, SEM_standard error of measurement, SDC_smallest detectable change, ICC_intraclass correlation coefficient, M_male, F_female

Eighteen studies matched the inclusion criteria and were included in the systematic review. The reference checking of the included studies did not generate additional relevant studies. Reproducibility and validity of the 6MWT were evaluated in the following 9 patient groups: cystic fibrosis (n=3), cerebral palsy (n=2), obesity (n=4), juvenile idiopathic arthritis (n=2), Duchenne muscular dystrophy (n=2), congenital heart disease (n=1), acute lymphoblastic anaemia(n=1), asthma (n=2),generalized hyper mobility (n=1)

DATA SYNTHESIS AND ANALYSIS

Comparison of 6MWT testing procedures: Test procedures showed large variation. The walk-

ing course ranged from 8 to 70 m, but was less than 30 m in approximately half of the studies. A pretesting resting period was applied in 40% of the studies.

Encouragement was standardized in most of the studies. However, although studies followed the standardized phrases in accordance with ATS guidelines, other studies used continuous verbal encouragement. A *safety chaser* was defined as an assistant who walked behind the patient during the test and provided extra encouragement, assisted in the case of fall incidents, and performed additional measurements [31].

Reliability: Test-retest reliability was evaluated in 9 studies. The methodological quality of the studies on children with cystic fibrosis was rated fair [25,29] and poor [24]. The quality of the studies on children with cerebral palsy was rated excellent(35) and fair [27]. The quality of the studies on children with Duchenne muscular dystrophy [31], and obesity [33] was rated fair and good respectively.

Main methodological flaws included inadequate statistical procedures,(24)inappropriate time intervals between tests (27–29) and ambiguity about independent administrations.(24,27)Six studies reached high levels of test-retest reliability (ICC_.84 –.98), and 1 study showed a strong correlation between the test and retest, (*rp*_.90, *P*_.001). The level of evidence in the studies on children with Duchenne muscular dystrophy was reduced to limited because of their small sample sizes.

Measurement error: Measurement error was evaluated in 8 studies. The methodological quality of the studies on children with cystic fibrosis was rated fair [24]. The quality of the studies on children with cerebral palsy was rated excellent and fair [35]. The quality of the studies on children with obesity [33] was rated good. The quality of the studies on children with congenital heart disease [32] and Duchenne muscular dystrophy [31] was rated fair and poor. Limits of agreement were determined in 6 studies and varied from _133 m to 101 m in children with cystic fibrosis [27] and from _14 m to 12 m in children with congenital heart disease [32].

Hypothesis testing (validity): Hypothesis testing was performed in studies, convergent validity was assessed in studies, and discriminative validity was assessed in studies. The methodological quality of the studies regarding children with obesity was rated fair [14,28] and poor [33]. The quality of the studies on children with cystic fibrosis was rated fair [25] and poor [24]. The quality of the studies on children with Duchenne muscular dystrophy [31], juvenile idiopathic arthritis [34], was rated fair. The quality of the studies on children with cerebral palsy, and congenital heart disease [32], was rated poor. Main methodological flaws included the absence of a predefined hypothesis [32,38] inadequate statistical analysis [24,32] and validity issues concerning test performance [31].

Sample Size: The sample size in most of the included studies was small. In general, small sample sizes lead to reduction of power and hinder the ability to generalize the results to the reference population [39]. However, the required sample size to generate sufficient power in a study is not fixed but can be calculated based on the effect size and the significance criterion. Regrettably, none of the studies

Reported a power analysis; therefore, it remained unclear whether the sample sizes were adequate. In the best evidence synthesis, studies on the same patient group with sufficient methodological quality were pooled to increase sample size and extend the level of evidence.

DISCUSSION

Eighteen studies were evaluated on both methodological quality and quality criteria of the measurement properties of the 6MWT in various pediatric conditions. The best evidence synthesis of the 18 included studies provides an overview of the current body of knowledge about the measurement properties of the 6MWT in various pediatric conditions.

Methodological Considerations: The methodological quality of the studies varied between poor and excellent. Notably, the studies on hypothesis testing received remarkably low ratings on methodological quality. These low ratings were due mainly to the fact that few studies formulated clearly defined hypotheses.

Without specific hypotheses on expected mean

differences between known groups or expected correlations with other variables, it remains unclear whether the results reflect the construct to be measured and only little can be said about the validity of the 6MWT [40]. The importance of a clear statement on expected correlations in the assessment of validity of the 6MWT is even more important if we consider that the construct to be measured with the 6MWT in a given population is not clearly described in most of the studies. Moreover, the particular construct of the 6MWT in each case seems to depend largely on both the origin and severity of the functional limitations. The 6MWT reflects maximal exercise capacity in pediatric patients with moderate to severe pulmonary and cardiovascular conditions such as cystic fibrosis [25], congenital heart disease [32] but sub maximal exercise capacity in other chronic conditions [33,34,11]. This finding is in accordance with a prior study regarding the adult population [41]. Jehn et al [41] showed that the 6MWT reflects a maximum exercise response in patients with advanced heart failure, whereas it only constitutes a sub maximal exercise test in patients with mild heart failure and no functional limitations. Given the fact that the construct of the 6MWT depends on both the patient population and the disease severity, it seems no longer justified to label the 6MWT as a submaximal functional outcome measure before a proper validity assessment on the target population is performed, including both patients who are mildly and severely affected.

Evaluative Properties of the 6MWT (Reliability and Measurement Error): The reproducibility of an instrument reflects both reliability and measurement error parameters. Whereas the first parameter refers to the ability to distinguish among individuals and is mostly important when used for discriminative purposes, the latter parameter refers to the ability of the instrument to detect relevant changes and is more suitable for evaluative purposes. The resent systematic review provides sufficient evidence that the 6MWT is capable of distinguishing not only between children with various conditions and their peers who are healthy but also within patient populations. Although the measurement error for several subgroups has been determined, the evaluative value of the 6MWT remains unclear. All studies on measurement error received an "indeterminate" rating.

Clinical Implications: Clinicians can use the results of this study to support their diagnostic process and evaluation of interventions in children with various conditions. The best evidence synthesis provides a clear overview of the current knowledge of the reliability and validity of the 6MWT in specific conditions and can guide clinicians in their decision of whether to use the 6MWT and in interpreting the outcome. If a clinician, for example, wants to evaluate physical fitness in a child with juvenile idiopathic arthritis, he or she might consider the 6MWT. The best evidence synthesis of studies of juvenile idiopathic arthritis, however, shows that the 6MWT is likely to be a poor indicator for aerobic capacity and that it is unknown whether the 6MWT provides reproducible test results. Based on this information, a clinician will possibly decide to use another outcome measure such as the maximal cardiopulmonary exercise test. The lack of evidence for the measurement properties of the 6MWT for many pediatric conditions does not automatically mean that the 6MWT cannot be applied. It does demand a critical approach of the clinician to the aim and the results of the test. Without knowledge about the construct of the 6MWT for a specific population and the measurement error between repeated measurements, results should be interpreted with caution and alternative outcome measures must be considered.

CONCLUSION

Evidence for measurement properties of the 6MWT varies greatly among pediatric conditions. Further research is needed in all patient groups to explore the ability of the 6MWT to measure significant and clinically important changes. Until further research is conducted, changes measured with the 6MWT should be interpreted with caution and attention should be paid to whether it is a meaningful change for the individual patient. Future studies toward consensus regarding modified test procedures in the pediatric population are recommended.

Conflicts of interest: **None**

REFERENCES

[1]. http://www.wellnessproposals.com/health-promotion/presentations/definitions-physical-activity-exercise-fitness.pdf

[2]. The Validity and Reliability of Fitness Tests for Children: A Review Margaret J. Safrit. Pediatric Exercise Science, 1990, 2, 9-28.

[3]. Vanessa Noonan, Elizabeth Dean:Submaximal Exercise Testing:Clinical Application and Interpretation, Physical Therapy . Volume 80 . Number 8 . August 2000

[4]. Balke BA et al A simple field test for the assessment of physical fitness. Respiratory Civ Aeromed respiratory Inst US. 1963; 53:1-8.

[5]. Rehab measures: 6 MWT.

[6]. Brett Sears 2/13-about.com. health's disease and condition.

[7]. Hassan J et al (2010) Br. J sports medicine;44:270-274.

[8]. Hassan J, van der Net J, Helders PJM, Prakken BJ, Takken T. Six minute walk test in children with chronic conditions. Br J Sports Med 2010; 44:270 - 274. doi:270 10.1136/bjsm.2008.048512.

[9]. Geiger R, Strasak, A, Treml B, et al. Six minute walk test in children and adolescents. J Pediatr 2007; 150:395-399.

[10]. Li AM, Lin J, Au JT, et al. Standard references for the six minute walk in healthy children aged 7 - 16 years. Am J Respir Crit Care Med 2007; 176; 174 - 180.

[11]. Paap E, van der Net J, Helders PJM, Takken T. Physiologic response of the six-minute walk test in children with juvenile idiopathic arthritis. Arth Care Res 2005; 53:351-356.

[12]. De Groot jf, Takken T. The six-minute walk test in paediatric populations. Clinimetrics

[13]. Geiger RÂ Willeit J, Rummel M, hogler W, Stubbing K, Strasak A, Geiger h, Stein HI, rauchenzauner M.Â Six-minute walk distance in overweight children and adolescents: effects of a weight-reducing program. J Pediatr, 2011; 158(3):447-51.

[14]. Elloumi M. Makni E, Ounis QB, moalla W, zbidi A, Zaoueli M, Lac G, Tabka Z.Â Six-minute walkingtest and the assessment of cardiorespiiratory responses during weight-loss programmes in obese children. Physiother Res, 2011; 16(1):32-42.

[15]. Solway S, Brooks D, Lacasse Y, Thomas S. A qualitative systemic overview of the measurement properties of functional walk tests used in the cardiorespiratory domain. Chest 2001; 119: 256–270.

[16].http://www.cosmed.com/hires/presentation/Spiropalm_6MWT_intro_2013_EN.pdf

[17]. The Six-Minute Walk Test in Chronic Pediatric Conditions: A Systematic Review of Measurement Properties. Bart Bartels, Janke F. de Groot, Caroline B. Terwee.

[18]. Wraith JE, Clarke LA, Beck M, et al. Enzyme replacement therapy for mucopolysaccharidosis I: a randomized, doubleblinded, placebo-controlled, multinational study of recombinant human alpha-Liduronidase (laronidase). J Pediatr. 2004;144:581–588.

[19]. Goemans NM, Tulinius M, Van Den Akker JT, et al. Systemic administration ofPRO051 in Duchenne's muscular dystrophy [erratum in: N Engl J Med. 2011;365:1361]. N Engl J Med. 2011;364:1513–1522.

[20]. de Groot JF, Takken T, van Brussel M, et al. Randomized controlled study of homebased treadmill training for ambulatory children with spina bifida. Neurorehabil Neural Repair. 2011;25:597–606.

[21]. Geiger R, Strasak A, Treml B, et al. Sixminute walk test in children and adolescents. J Pediatr. 2007;150:395–399, e1–e2.

[22]. Motor Performance and Functional Exercise Capacity in Survivors of Pediatric Acute Lymphoblastic Leukemia. Annelies Hartman et al. Pediatr Blood Cancer DOI 10.1002/pbc

[23]. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: guidelines for the Six- Minute Walk Test. Am J Respir Crit Care Med. 2002;166:111–117.

[24]. Cunha MT, Rozov T, de Oliveira RC, Jardim JR. Six-minute walk test in children and adolescents with cystic fibrosis. Pediatr Pulmonol. 2006;41:618–622.

[25]. Gulmans VA, van Veldhoven NH, de Meer K, Helders PJ. The Six-Minute Walking Test in children with cystic fibrosis: reliability and validity. Pediatr Pulmonol.1996;22:85–89.

[26]. Is the six-minute walk test correlated with disease control and quality of life in children with asthma? Hasan YÜKSEL et al. Turk J Med Sci 2012; 42 (5): 839-844.

[27]. Maher CA, Williams MT, Olds TS. The sixminute walk test for children with cerebral palsy. Int J Rehabil Res. 2008;31:185– 188.

[28]. Makni E, Moalla W, Trabelsi Y, et al. Sixminute walking test predicts maximal fat oxidation in obese children. Int J Obes (Lond). 2012;36:908–913.

[29]. Mandrusiak A, Maurer C, MacDonald J, et al. Functional capacity tests in young people with cystic fibrosis. NZ J Physiother. 2009;37: 13–16

[30]. Mazzone E, Vasco G, Sormani MP, et al. Functional changes in Duchenne muscular dystrophy: a 12-month longitudinal cohort study. Neurology. 2011;77:250–256.

[31]. McDonald CM, Henricson EK, Han JJ, et al. The 6-minute walk test as a new outcome measure in Duchenne muscular dystrophy. Muscle Nerve. 2010;41:500–510

[32]. Six-Minute Walking Test to Assess Exercise Tolerance and Cardiorespiratory Responses during Training Program in Children with Congenital Heart Disease.W. Moalla et al

[33]. Morinder G, Mattsson E, Sollander C, et al. Six-minute walk test in obese children and adolescents: reproducibility and validity. Physiother Res Int. 2009; 14: 91–104.

[34]. Lelieveld OT, Takken T, van der Net J, van Weert E. Validity of the 6-minute walking test in juvenile idiopathic arthritis. Arthritis Rheum. 2005;53: 304–307.

[35]. Thompson P, Beath T, Bell J, et al. Test retest reliability of the 10-metre fast walk test and 6-minute walk test in ambulatory school-aged children with cerebral palsy. Dev Med Child Neurol. 2008; 50: 370–376.

[36]. Motor Performance in Children with Generalized Hypermobility: The Influence of Muscle Strength and Exercise Capacity. Yvonne B. Hanewinkel-van Kleef.

[37]. Melo, Andressa Lais Salvador de et al. EXERCISE TOLERANCE, PULMONARY FUNCTION, RESPIRATORY MUSCLE STRENGTH, AND QUALITY OF LIFE IN CHILDREN AND ADOLESCENTS WITH RHEUMATIC HEART DISEASETOLERÂNCIA AO EXERCÍCIO, FUNÇÃO PULMONAR, FORÇA MUSCULAR RESPIRATÓRIA E QUALIDADE DE VIDA EM CRIANÇAS E ADOLESCENTES COM CARDIOPATIA REUMÁTICA. Revista paulista de pediatria : orgao oficial da Sociedade de Pediatria de Sao Paulovol.2018;36(2):199-206.

[38]. Montes J, McDermott MP, Martens WB, et al. Six-Minute Walk Test demonstrates motor fatigue in spinal muscular atrophy. Neurology. 2010;75:833–838.

[39]. Portney LG, Watkins MP. Foundations of Clinical Research: Applications to Practice. 3rd ed. Upper Saddle River, NJ: Pearson Prentice Hall; 2008.

[40]. Alves VL, Avanzi O. Objective assessment of the cardiorespiratory function of adolescents with idiopathic scoliosis through the Six-Minute Walk Test. Spine (Phila Pa 1976). 2009;34:926–929.

[41]. Jehn M, Halle M, Schuster T, et al. The 6-min walk test in heart failure: is it a max or sub-maximum exercise test? Eur J Appl Physiol. 2009;107:317–323.

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