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Validity and Reliability of Curl-Up Test on Assessing the Core Endurance for Kindergarten Children in Hong Kong

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Abstract

Objective: The purpose of this study was to examine the test-retest reliability and the criterion validity of a curl-up test (CUT) as a measure of core stability, core endurance and dynamic stability in kindergarten children. CUT performance was also compared to half hold lying test (HHLT) and walking time on course (WTC) among without obstacle, with low obstacle and high obstacle measures of core stability, core endurance and dynamic stability.

Methods: To estimate reliability, 33 males and 27 female kindergarten children (M aged=4.5 years old) performed the CUT on 2 different days. In the validity phase of the study, scores of all participants were obtained on three field test measures of core stability, core endurance and dynamic stability (CUT, HHLT and WTC).

Results: Results indicate that the MCU test has no significant correlation on intra-class test-retest reliability ($R=0.13$, $p>0.01$). The criterion validity of the CUT for kindergarten children has is comparable to that of the HHLT($r=0.98$, $p<0.01$) and WTC without obstacle($r=0.96$, $p<0.01$), with low obstacle ($r=0.96$, $p<0.01$) and with high obstacle ($r=0.98$, $p<0.01$). Result indicates that the CUT test cannot produces reasonably accurate and stable measures of core stability, core endurance and dynamic stability.

Conclusion: These preliminary findings provide evidences into the CUT test cannot produces reasonably accurate and stable measures of core stability, core endurance and dynamic stability for kindergarten children.

Keywords: Curl-up test; Core stability; Core endurance; Dynamic stability; Kindergarten children

Introduction

The benefits of physical activity and sport are extensively examined in the literature [1-13], whilst fundamental movement skills are important determinants of physical activity. In an attempt to improve infants' health, development of fundamental skills has been examined. The infant's development of postural responses of her body is following a cephalocaudal progression starting from the head control and then the moving distally to the trunk, arms as well as finally the legs. It has also shown that the postural response organization in the 4 to 6 years old children's synergies were more variable and longer in latency than in the 15-month- to 3-year-old children, the 7 to 10 years old children, even the adults [14]. The development of posture was influenced by the interaction of many variables which included muscle control, anthropometrics, sensory functioning and the environment [15]. In terms of the general sequence of development for newborn babies, their trunk extensor strength was gained and become balanced with flexor strength so that these gains in force were beneficial to develop the sitting and standing skill for them [16]. The process of developing and refining fundamental movement ability was involved for the preschool children aged 4-6 years old [17].

The fundamental movement phase which represents a time for young children exploring the movement actively started at two to seven years old [18]. For learning the fundamental movement skills (FMS), these composed loco motor skills which involved moving body through space (e.g. running, jumping, skipping, hopping and sliding) and object control skills which involved manipulating and projecting objects (e.g. throwing, catching, dribbling, kicking and striking balls) [19].

Achieving the well-developed FMS was the important factor in developing children's physical activity habits in the critical period of preschool years (aged from 3 to 5 years old) [20]. In this period, it was rapid growth for children's brain and neuromuscular maturation [21] which were important for acquiring the motor skill so that the higher levels of physical activity and motor skill levels could be increased in future sport participation and self- efficacy [22]. On the other hand, the muscular control of trunk was the primary importance in the development of advanced locomotor skill [23]. The stability of spine would be also contributed to strength, endurance and neuromuscular of core musculature significantly [24]. To move forward with the defining the relationship between the core endurance and fundamental movement skills, the different views in the body of literature should be recognized. For the recent study, it has motioned that the some level of general mobility and overall function were related to core musculatures [25-27]. The primacy of truck control was underlain nearly all function which involved head control, eye-hand coordination, reach and hand function and respiratory support [28]. The CUT was a measure of abdominal strength endurance which was the significant components required for performing a curl-up [23,29].

Materials and Methods

Participants

Sixty kindergarten children in good health (33 boys and 27 girls, M

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age=4.5 years) were recruited from a local kindergarten to participate in the reliability and validity phrase of the study. The criteria for exclusion in the study were that the participants had a parents reported in regarding history of medical, neurological, orthopedic (including wore any type of orthotic device), balance or visual disorders or had ever been treated for neck pain/injury and any history of back pain/injury within the past 6 weeks.

Procedures

The field test was operated with the following sequence: curl-up test, star excursion balance test and half hold lying test. The whole participants were arranged to watch the films or read the story books in the classroom for waiting the field test. Five participants were formed a group and asked to perform one test movement in each time and one instructor was responsible to one participant. The assessment with an accurate demonstration and verbal description of the movement were provided by the instructors. Then, the practice trials were also provided for assuring the participants understands what to do. Moreover, the additional demonstration was performed when the participants did not appear to understand the test. After performing the curl-up test, the participants were asked to go back to classroom and rest. The other group was asked to perform a test by the instructors when the one group was resting so that the groups were rotated after each test.

Curl up test

The participants lied in a supine position on the yoga mat and the knees were fixed to approximately 140 degree in which the examiner would measure the degree with a goniometer and the legs slightly apart as well as the feet was flat on the yoga mat. For using the goniometer, the midpoint of goniometer was aligned with the lateral side of knee joint; the arms of goniometer was aligned with longitudinal axis of thigh and the lateral malleolus of ankle [30]. Besides, the participant's arms were straight and parallel to the lateral side of trunk with palms of hands resting on the mat. The participant's fingers were stretched out and the head was in contact with the yoga mat. In addition, their feet were extended as far as possible from the hip while keeping the feet to remain flat on the yoga mat. The 3 inch measuring strip was placed on the yoga mat under the participant's leg so that their fingertips were just resting on the nearest edge of the measuring strip. Moreover, a piece of paper was placed under the participant's head and the paper would assist the examiners in determining whether the participant's head touched down on the yoga mat each repetition.

Half hold lying test

The participants lied in supine position on the yoga mat and supine with the arms extended anterior to the trunk. The participant's knees were flexed to 90° in which the examiner would measure it with a goniometer. For using the goniometer, the midpoint of goniometer was aligned with the lateral side of knee joint; the arms of goniometer were aligned with longitudinal axis of thigh and the lateral malleolus of ankle [30]. Besides, both feet were flat on the yoga mat and secured by a strap across the dorsa of the feet. Then, the participants raised their head slowly, followed by shoulders and upper chest until the examiners said 'Hold it' when their scapulae was totally off the yoga mat. Walking time on course tests involved without obstacle, with a low obstacle and with high obstacle.

The soft block acting as the obstacles (depth, 11.5 cm and width, 23.5 cm) with difference heights (5 cm and 10 cm) were set at the halfway point of a mat (10 cm width and 200 cm length). Besides, the starting line and turning line (length, 10 cm and width, 10 cm) were marked separately in the two extremities of the mat. The participants were asked to walk within the mat under three conditions involved without obstacle, low obstacle and high obstacle. The time was measured from when the participant crossed the starting line and then reached the turning line until returning to the starting point again. The participants were instructed that they should change the direction quickly after reaching the turning line and return to the starting line as well as walking as fast as possible during the walking test. The participants were performed the test again if they fell or touch the obstacle by their foot while walking.

Monitoring

To find out the validity and reliability of muscular endurance in abdominal of the participants, the curl-up test with knees flexed and feet unanchored [31,32] was adopted. The field test was operated with the following sequence: curl-up test, walking time on course test and half hold lying test. All participants were arranged to watch the films or read the story books in the classroom for waiting the field test. After performing the curl-up test, the participants were asked to go back to classroom and rest. The other group was asked to perform a test by the instructors when the one group was resting so that the groups were rotated after each test.

Statistical analysis

Test-retest reliability was estimated by calculating the intra-class coefficient(R). Pearson correlation analysis was used to determine the relationship between CUT, HHLT and WTC. Descriptive statistics including mean and standard errors of outcomes were reported.

Results

Descriptive statistics of participants in the reliability phase of the study are present in Table 1. Test-retest intra-class R value is presented in Table 2. No significant positive correlation were found between trial one and trial two of curl-up test (R=0.13, p>0.01).

Assessing the predictive validity of curl-up test by reviewing it's the relationship with half hold lying test and walking time on course test. The curl-up test showed a moderate significant positive correlation with half hold lying test in trail one (r=0.449, N=60, p<0.01). Besides, the strong to moderate significant negative correlation were found in the curl-up test by the walking time on course test without obstacle (r=-0.618, N=60, p<0.01), with low obstacle (r=-0.517, N=60, p<0.01) and with high obstacle (r=-0.558, N=60, p<0.01) in the trail one. The Tables 1 and 2 showed the correlation of the curl-up tests between half hold lying test and walking time on course test in trial one respectively. For the trial two of predictive validity, the curl-up test was weak significant positive correlation with half hold test (r=0.347, N=60, p<0.01).

(n=60)	M	SD	Minimum	Maximum
Age (years)	4.46	0.77	3	5
Exercise habits	1.57	0.50	1	2
Interest in sport	3.37	1.13	1	5

Note: Exercise habits (Self-reported on how many times exercise per week)

Interest in sport (Scores ranged from 1 to 5; 5 being highly interested)

Table 1: Descriptive results of age, exercise habits and interest in sport of all the

	R
	Test and retest
Total (n=60)	0.13

Table 2: Test-retest intra-class reliability estimates and 99% confidence intervals for the curl-up test reliability study.

Besides, there was no significant negative correlation between curl-up test and walking time on course test without obstacle (r=-0.209, N=60, p>0.01), with low obstacle (r= -0.261, N=60, p>0.01) and high obstacle (r=-0.287, N=60, p>0.01). The Tables 1 and 2 showed the correlation of the curl-up tests between half hold lying test and walking time on course test in trail two, respectively.

A partial correlation among curl-up test, half hold lying test and walking time on course test in trail one and trail two were conducted by controlling for age, gender, exercise habits and interest in sport. The partial correlation between curl-up test and half hold lying test was no significant in the trial one (r=0.121, p>0.01) but significant in trial two (r=0.347, p<0.01). The partial correlation between curl-up test and walking time on course without obstacle was significant (r=-0.563, p<0.01) but no significant in trial two (r=-0.038, p>0.01). The partial correlation between curl-up test and walking time on course with low obstacle was significant in trail one (r=-0.342, p=0.01) but no significant in trail two (r=-0.201, p>0.01) while the partial correlation between curl-up test and walking time on course test with high obstacle in trial one was significant (r=-0.534, p<0.01) but no significant in trial two (r=-0.287, p>0.01).

Discussion

The purpose of this study was to examine the validity and reliability of curl-up test by assessing the correlation among curl-up test, half hold lying test and walking time on course test.

A possible explanation is on curl-up test result which is in terms of the lack of enough resting times for participants performing the trial one and trial two of three tests. The only 1 h of resting time were provided for the participants among the tests so that the fatigue of core musculatures was not recovered. They would also feel painful due to the localized muscle fatigue probably. This discomfort was particularly evident affecting the results of the three tests. Therefore, the young participants might have poor performance because of the anticipation of pain when performing the retest.

The variables which involved motivation, muscle substitution and test administration were strongly associated with the scores of curl-up test so the motivation of participants in this study was the other possible factor in affecting the correlation of three tests [33]. The kindergarten children were no idea or any cognition of those tests during the process of performance, although the verbal instruction was provided for participants before the test. In addition, those tests were repeated movement exercise so the participants showed no interest in trail two tests. Many K3 children aged 5 years old quickly lost the interest in the retest and need to be persuaded to continue their testing. The sticker would be given to the children by the examiners when they were the highest scores on each test. They were also difficult to pay attention and focus for performing the curl-up test and half hold lying test in both trails since that they would be disturbed and look around the near participants. Thus, the test results might have the difference if the children were tested without the other participants in the room and without a reward.

There were also the potential factors causing the error during the curl-up test for kindergarten children such as administering the measurement. The measuring strip would be moved easily when the participants lying down on the mat each time and they would catch the measuring strip when curling up with moving the hand forward so that the range of curl-up would be affected. The participants caught their knee in holding the upper body sometimes when they performing the half hold lying time so it would assist them holding longer time in this test and the results were influenced. A study was also mentioned that the stable body position on the mat was unable maintained for some college-age student due to the rapid body movement of them. Although the participants performed the curl-up test with the slow rhythm, the criterion position of the fingers on measuring strip would influence the results.

Reviewing of the settings of curl-up test, it was modified from 1 minute to 30 seconds since the difficulty of curl-up test would be simplified as a field test for kindergarten children. However, it was low coefficient with half hold lying test. It might be influenced by the two different types of muscular concentration in curl-up test and half hold lying test. The core muscles were attributed by concentric concentration in performing the curl-up test but in the half hold lying test was isometric concentration. The 1 min speed test was low correlation and a weak relationship with the isokinetic measures of abdominal strength [34]. The other study has mentioned that the reach criterion in curl-up test would have depended on shoulder girdle flexibility and the upper spine flexibility [35].

The strength of this study pertains to some objective measures used to increase the objectivity [36-38]. However, some in-depth statistical analyses [39,40] were not adopted due to the nature of data collected in this study. This may affect the validity of findings [41,42]. The total exercise of children which may affect the motor symptoms was not evaluated. In addition, the impact of gender was also not evaluated in this study.

Conclusion

These preliminary findings provide evidences into the CUT test cannot produces reasonably accurate and stable measures of core stability, core endurance and dynamic stability for kindergarten children. Further is done research to develop a reliable measurement for assessing the core endurance for kindergarten children in Hong Kong.

References

1. Lee KY, Lee PH, Macfarlane D (2014) Associations between moderate-to-vigorous physical activity and neighbourhood recreational facilities: The features of the facilities matter. Int J Environ Res Public Health 11: 12594-12610.
2. Lam MHS, Cheung SY, Chow BC (2011a) The effects of Tai-Chi-Soft-Ball training on physical functional health of Chinese older adult. J Hum Sport Exerc 6: 540-553.
3. Fung L, Lam MHS (2012) Effectiveness of a progressive stepping program on lower limb function in community dwelling older adults. J Exerc Sci Fit 10: 8-11.
4. Lee KY, Lam MHS, Lam NKT, Sin HMY, Louis LHT (2014) Wrestling and Health. In S. FONG (Ed.), Martial Arts for Health: Translating Research into Practice. CA, USA: OMICS Group Incorporation, pp. 38-41.
5. Lam MHS (2016) Exercise game exhilarates the elderly: A challenge to traditional training. J Athl Enhanc 5: 1.
6. Li Ej, Lam MHS, Louie LHT, Li SSS (2012) An Analysis on History and Cultural Background of Chinese Tai Chi Soft Ball. Asian J Phys Educ Recreat 18: 27-30.
7. Lam MHS, Cheung SY, Chow BC (2011b) Effects of Tai Chi soft ball training on health-related quality of life of older adults with functional limitations. Asian J Gerontol Geriatr 6: 65-71.
8. Lau PW, Lam MHS, Leung BW (2010) National Identity and the Beijing Olympics: School Children's Responses in Mainland China, Taiwan and Hong Kong. Proc Soc Behav Sci 2: 6729-6738.
9. Lam MHS, Kok EYL, Louie HTL, Lee KY (2014) External Chinese martial arts and health. In S. FONG (Ed.), Martial Arts for Health: Translating Research into Practice. CA, USA: OMICS Group Incorporation, pp. 16-21.

10. Ho G, Yiu EYM, Lam MHS (2016) The Hong Kong games in the eyes of local sports and recreation students. Int J Hist Sport 33: 1209-1225.
11. Lam MHS, Leung AYM (2016) The effectiveness of health literacy oriented programs on physical activity behaviour in middle aged and older adults with type 2 diabetes: A systematic review. Health Psychol Res 4: 5595.
12. Lam MHS (2010) Management evaluation of the healthy athlete program of 2007 Shanghai Special Olympics World Summer Games. Asian J Phys Educ Recreat 16.
13. Lam MHS, Leung AYM, Chan SSC (2011) Psychological and cognitive determinants of the health literacy on soon to be aged and older adults: A systematic review. Imanagers J Nurs 1: 46.
14. Woollacott MH, Shumway-Cook A (1990) Changes in posture control across the life span – a systems approach. Phys Ther 70: 799-807.
15. Jensen JL, Korff T (2005) The puzzles of motor development: How the study of developmental biomechanics contributes to the puzzle solutions. Infant Child Dev 14: 501.
16. Thelen E, Cooke DW (1987) Relationship between newborn stepping and later walking: a new interpretation. Dev Med Child Neurol 29: 380-393.
17. Payne VG, Isaacs LD (2016) Human motor development: A lifespan approach: Routledge.
18. Gallahue DL, Ozmun JC (1998) Understanding motor development: Infants, children, adolescents, adults: McGraw-Hill Humanities, Social Sciences and World Languages.
19. Haywood K, Getchell N (2009) Life span motor development:. Human Kinetics.
20. Ward DS, Vaughn A, McWilliams C, Hales D (2010) Interventions for increasing physical activity at child care. Med Sci Sports Exerc 42: 526-534.
21. Malina RM, Bouchard C, Bar-Or O (2004) Growth, maturation and physical activity. Human Kinetics.
22. Okely AD, Booth ML (2004) Mastery of fundamental movement skills among children in New South Wales: prevalence and socio demographic distribution. J Sci Med Sport 7: 358-372.
23. Safrit MJ, Wood TM (1995) Introduction to measurement in physical education and exercise science.
24. Akuthota V, Ferreiro A, Moore T, Fredericson M (2008) Core stability exercise principles. Curr Sports Med Rep 7: 39-44.
25. Kibler WB, Press J, Sciascia A (2006) The role of core stability in athletic function. Sports Med 36: 189-198.
26. Willson JD, Dougherty CP, Ireland ML, Davis IM (2005) Core stability and its relationship to lower extremity function and injury. J Am Acad Orthop Surg 13: 316-325.
27. Young JL, Herring SA, Press JM, Casazza BA (1996) the influence of the spine on the shoulder in the throwing athlete. J Back Musculoskelet Rehabil 7: 5-17.
28. Kott K, Held S (2010) Refinement, reliability and validity of the segmental assessment of trunk control. Pediatr Phys Ther 22: 258.
29. Baumgartner TA, Jackson AS (1998) Measurement for evaluation in physical education and exercise science (No. Ed. 6) WCB/McGraw-Hill.
30. Norkin CC, White DJ (2016) Measurement of joint motion: A guide to goniometry: FA Davis.
31. Freedson PS, Cureton KJ, Heath GW (2000) Status of field-based fitness testing in children and youth. Preventive medicine 31: S77-S85.
32. Macfarlane PA (1993) Out with the sit-up, in with the curl-up! J Phys Educ Recreat Dance 64: 62-66.
33. Knudson D (2001) The validity of recent curl-up tests in young adults. J Strength Cond Res 15: 81-85.
34. Hall GL, Hetzler RK, Perrin D, Weltman A (1992) Relationship of timed sit-up tests to isokinetic abdominal strength. Res Q Exerc Sport 63: 80-84.
35. Diener MH, Golding LA, Diener D (1995) Validity and reliability of a 1 min half sit-up test of abdominal strength and endurance. Res Sports Med 6: 105-119.
36. Lee KY, Macfarlane D, Cerin E (2013a) Objective evaluation of recreational facilities: Development and reliability of the recreational facility audit tool. J Park Recreat Admin 31: 92-109.
37. Lee KY, Lam MHS, Lee PH (2017) Distance from home to the nearest tobacco outlet may not reflect the true accessibility. JAMA Intern Med 177: 287-287.
38. Lee KY, Lam MHS, Deng Y (2017b) Measuring post-concussive activity levels of patients: Step count or activity intensity?
39. Deng Y, Lee KY, Lam MHS, Lee PH (2016) Understanding socio-behavioral mitigators of depressive symptoms among US young adults. Behav Med 42: 217-226.
40. Lee PH, Tse AC, Lee KY (2016) A new statistical model for the day reconstruction method. Int J Methods Psychiatr Res.
41. Lee KY, Lam MHS, Deng Y (2017a) Interventions for anxiety and depression in conflict-affected areas. JAMA 317: 1376-1376.
42. Lam MHS, Tung K, Man DP, Lee KY, Lei Y, et al. (2017) Examining lower limb injuries among male amateur soccer player. J Yoga Phys Ther 7: 264.

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