Journal of Sport Science Technology and Physical Activities
ISSN : 1112-4032
eISSN 2543-3776

VOL:18 / N°: 2 December (2021), p : 99/110

Validation of the Basketball Throw Test as Health-Related Measure for Assessing the Upper-Body Muscular Strength of Algerian Primary School Children

Mohammed Besseddik Belhaidas [1] ; Dahoune Oumri [2] ; Benkhaled Elhadj [3]; Atallah Ahmed [4]

[1,2,3,4] University Of Mostaganem, Institute Of Physical Education And Sports , Laboratory For Optimizing Research Programmes On Physical and Sports Activities , Mostaganem , Algeria.

[1] mohamed.belhaidas.etu@univ-mosta.dz, [2]oumri.dahoune@univ-mosta.dz
[3]hqdj.benkhaled@univ-mosta.dz,[4] ahmed.atallah@univ-mosta.dz

ARTICLE INFORMATION

Original Research Paper
Received: 14/07/2021
Accepted: 17/10/2021
Published 01/12 /2021

Keywords:
Health-Related Fitness –Physical Education – Sports – Psychometric

Corresponding author:
Mohammed Besseddik Belhaidas
e-mail:
mohamed.belhaidas.etu@univ-mosta.dz

Abstract

The aim of our study is to investigate the validity of the Basketball Throw test as health-related Measure for assessing the Upper-Body muscular strength of primary school children, for this purpose, we used the cross-sectional method On a sample composed of 65 primary school children (33 boys, 32 girls), mean age 8,75 years, SD = 1,47 years Chosen randomly, and for data collection, we used a flexible type measure and analog scale (to measure height and weight respectively) for the anthropometrics, the Basketball Throw test and Hand-grip test (criterion test) to measure the upper-body muscular strength. After collecting the data and having treated them statistically, we conclude that the Basketball Throw test is a valid measure of primary school children's upper-body strength/power and is slightly influenced by BMI. On this basis, the study recommended to include this test on the field-based health-related fitness test batteries.

I. Introduction

Health related fitness is referring to those specific physical fitness components that strongly linked to health and may reduce the potential of health problem risks (Brehm, 2014). Muscular strength is one of the health related fitness components can be defined as the maximum amount of force that can be generated by single or group of muscles in one contraction (Frontera et al., 2006). Muscular strength is important for everyone allows us for doing endless activities and task in our life (any physical action needs strength) thus, living well and independently (Barker, 2004; Dahoune et al., 2018 Daho, 2018). Because of its important role in life muscular strength testing is placed. There are numerous fitness test batteries assessing the health related fitness however FITNESSGRAM® is probably the advanced one and the most popular in the world (Burns et al., 2014). The advisory board of FITNESSGRAM® recommended the use of the 90° Push-up test for assessing Muscular strength (Plowman & Meredith, 2013). It is practical over the pull-up and the Flexed-arm hang because it requires no equipment and few zero scores occurrence (Plowman & Meredith, 2013). However, the 90 PU test is lacking objectivity for primary school children (0.45 for girls and 0.75 for boys) (McManis et al., 2000). Thus, testing students counting each other's 90° push-ups does not seem appropriate (McManis et al., 2000). Furthermore, Fernandez-Santos and his colleagues observed, in their study, that a high number of the participants was scored zero (66.3% of boys,70.7% of girls) in the 90° push-up test (Fernandez-Santos et al., 2016). Then, several problems with the test were during the testing sessions; Counting the number of correctly-performed 90°push-ups was difficult for college students, children and even the trained testers, founding difficulty in discriminating between properly and improperly- performed 90° Push-up. The children found it difficult understanding how to perform it correctly in spite of practicing the test with their arm form being corrected, and many of whom being unable to lift their hips off of the ground. They lay on the ground and extended their elbows but their hips remained on the ground. Many of them were weak, being unable to maintain the correct form as their elbows often did not reach the required 90° angle. This test may be too difficult for primary school students. The difficulty of performance can be exponentially higher in time to the presented cadence (1 90° Push-up in 3 seconds) (McManis et al., 2000). Baumgartner and his colleagues revealed that the validity of using the 90° Push-up test for primary school children is still questionable (Baumgartner et al., 2015). There is clear evidence that the 90° Push-up test does not seem valid for assessing the MS/endurance for primary school children (Baumgartner et al., 2015; Fernandez-Santos et al., 2016; Pate et al., 1993; Woods et al., 1992). In other words, an alternative test is needed to be used for this population (primary school children). There are multiple tests used for assessing the upper-body MS. However, the Basketball Throw Test seems to be practical without the need of expensive equipments as it is entertaining for children. This standpoint has been confirmed by several experts using a simple electronic questionnaire. There are different Basketball Throw tests: the standing overhead forward throw (Fernandez-Santos et al., 2016; Vanhelst et al., 2016), and the seated chest pass (ACHPER, 2004). The seated position of the Basketball Throw test in this study eliminates the power that is commonly generated from the trunk and lower extremities in the other test (overhead throw) (Davis et al., 2008). Therefore, the Basketball Throw test validity is needed to be checked in order to be used in our area. Thus, our study aims at investigating the validity of the Basketball Throw test (seated position) for assessing the upper-body MS in Algerian primary-school children.

Method and Materials:

2.1. Participants :

The sample consists of 65 primary-school children, whose age ranged between 6 to 10 years (33 boys; 32 girls). They were selected randomly from the first, second, third, fourth and fifth grades (Mean age = 8,75 years, SD = 1,47 years) from the same primary school that is located in Matemore region- Mascara State. Descriptive statistics of the sample are presented in (Table 1). All the participants were free from any kind of musculoskeletal disorder throughout the process of testing (no one reported). The participants were verbally informed about the characteristics of the methods to be used and the purpose. Written consent was obtained from parents, and assent was obtained from participants prior to data collection so that they agree to participate in the. Furthermore, the university's institutional review board and the local school district approved the protocols being used in the study. The procedures follow the ethical standards of the latest version of Helsinki Declaration for experiments, including human subjects.

A sample of 65 seems to be adequate for estimating objectivity and reliability according to Baumgartner and Chung's study (Baumgartner & Chung, 2001) and whose findings is confirmed before (Morrow Jr & Jackson, 1993).

2.2. Materials

2.2.1Anthropometric measures:

Height and weight were measured with the participants barefoot, wearing the school's sport uniform. Weight was measured to the nearest 0.1 kg with an analog scale while the instruments were calibrated for ensuring accurate measures. Height was measured to the nearest 0.1 cm using a standard flexible measurement tape that was hanged on the wall with the participants standing erect, without shoes, and with evenly-distributed weight between both feet, heels together, arms relaxed at the sides, and the head in the horizontal plane. Body mass index was calculated as body mass (kg) was divided by the square of height in meters (m) (Belaidouni et al., 2019; Lotfi et al., 2019).

2.2.2.Muscular strength tests:

Basketball Throw test: Starting from the wall, a measuring tape is fixed along the ground. The student sits on the floor with back against the wall. Throughout the test buttocks, back, shoulders and head must stay in contact with the wall, and legs remain straight with closed feet. The student assumes the chest pass position with the elbow touching the wall. Then, he performs a chest pass attempt to achieve the longest pass possible. The tester measures the distance achieved. The distance is measured when the basketball first contacts the ground. Each student performs two trials. The longest distance is recorded in meters (ACHPER, 2004).

Hand-grip test:

The study participants had previously received brief instructions (verbal and demonstration) regarding measurement procedures. The dynamometer was periodically calibrated against known weights and to ensure that it is measuring precisely. Although The TKK dynamometer seems the best model and provide the highest criterion-related validity and reliability (España-Romero et al., 2010; Kolimechkov et al., 2020), we use Camry Digital hand grip Dynamometer model because it is the only available. The dynamometer was adjusted to the participant's hand size when required, then they were allowed to briefly practice it a couple of trials prior to assessment. HG was measured with the subject in a standing position, with the shoulder adducted and neutrally rotated and arms parallel but not in contact with the body ; performing the handgrip strength test with elbow extended appears to be the most appropriate protocol in order to evaluate maximal handgrip strength in children (Kolimechkov et al., 2020). Children were instructed to squeeze the handle of the dynamometer as hard as they could and to sustain the effort for3 to 5 seconds. Verbal encouragement (i.e., squeeze the hardest you can) was provided to children during testing. Children were given one-minute to rest between trials and alternating hands to minimize the effects of fatigue (Trossman & Li, 1989). Two trials were allowed with each limb and the average score was recorded as the peak grip strength (kg). Therefore, the HG values presented here combine the results of left- and right-handed subjects, without considering hand dominance(Garcia-Hermoso et al., 2019; Ramírez-Vélez et al., 2017). If a measurement showed a difference greater than 10% from previously obtained measurements, we did not retain that measurement and instead conducted a third trial (Omar et al., 2015).

2.3. Design and Procedure

We met with the students during their regularly-scheduled physical education class. Prior to the first testing session, the participants were verbally informed about the characteristics of the methods to be used and the purpose and letters (written consent) informing about and describing the study were delivered to the students' home (parents). Those who replied positively were accepted to participate. They were 5 groups from each primary school grade. All data collection took place during each group's physical education lesson on two testing sessions (because one hour is not enough to tale all the measurements), because, the physical education lesson has only one hour each week in the time-table of the primary school children. Anthropometric measures were taken firstly, then the hand grip, finally, the basketball throw test. All anthropometric measures and fitness tests were taken by one scorer to ensure consistency during data collection. Students were familiarized with both the Handgrip Dynamometer and Basketball Throw test, they were described and demonstrated to the students before the testing, using the protocols described above. Height, weight, age and the handgrip test were administered on session one for each group. The Basketball throw test was administered on second session for each group.

2.4. Statistical Analysis

The hypothesis of normality was analyzed via the Kolmogorov-Smirnov test (Muyor et al., 2014). Parametric analysis was performed because the data were normally distributed.

Descriptive values of the sample were calculated for: age, gender, BMI and each of the two measures of the upper-body muscular strength tests and demonstrates as Mean and ± SD. Pearson correlation coefficient; r was employed to determine relationship (validity) between basketball throw test and handgrip test individual scores and the BMI (Al-Din et al., 2020). In addition, the validity evidence was evaluated by the known-difference evidence by comparing the basketball throw of the youngest with the oldest age group (6, 10 years old respectively) using independent t-test because the data were normally distributed (Djamila ;2020 , Suhaila et al., 2020; Taha, 2018).

All analyses were performed using Statistical Package for Social Science (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp).

The significant level was set at $p < .05$.

II. Results

Descriptive statistics of the sample, including means and standard deviations, are presented in Table 1. The average distance of the basketball ball throw was 2.51 ± 0.64 cm, and the average muscular strength (hand-grip test) was of modified pull-ups was 13.11 ± 4.12 Kg. Correlation and Comparisons were made between the basketball ball throw and the hand-grip scores to establish validity evidence (Table2). The hand-grip test was considered the ‘‘criterion’’ measure. The basketball ball throw test scores were positively correlated with the hand-grip test scores (Figure 1) ($r = 0.77$, $p < 0.001$) and the BMI (0.30, $p < 0.05$). Further analysis was completed to explore different type of validity evidence. At this young age, strength seems to be influenced more by growth patterns than by gender differences (Gallahue et al., 2011). Because the strength of very young children increases gradually from year to year, a comparison was made between the scores from the basketball throw test and the handgrip test between the 6-year-old age group and the 10-year-old age group (Davis et al., 2008) and they were shown in (Table 3). The results show a significant difference in the basketball throw test scores between the 6-year-old group (1.61 ± 0.23) and the 10-year-old group (3.41 ± 0.27), $t = -12.64$, $p < 0.001$.

Table 1 Descriptive characteristics of the sample

	Boys (n= 33)	Girls (n= 32)	Total (n= 65)
	Mean ± SD	Mean ± SD	
age	7.88 ± 1.29	7.84 ± 1.29	7.86 ± 1.28
Height	1.39 ± 0.05	1.27 ± 0.07	1.33 ± 0.08
Weight	33.25 ± 7.44	26.40 ± 5.10	29.88 ± 7.23
BMI	16.99 ± (2.94	16.08 ± 2.09	16.54 ± 2.58
Basketball Throw	2.60 ± 0.65	2.41 ± 0.62	2.51 ± 0.64
Hand-grip	15.19 ± 4.01	10.97 ± 3.02	13.11 ± 4.12

BMI: Body Mass Index. SD: Standard Deviation

They also show a significant difference in the handgrip test scores between the 6-year-old group (9.46 ± 2.57) and the 10-year-old group (17.84 ± 1.96), t = -7.13, p < 0.001. The 10-year-old group demonstrated higher mean scores than the 6-year-old group.

Table 2 Bivariate Correlation Analysis Between Muscular Strength Tests and BMI:

Tests	Hand-grip	BMI
BMI	0.40, p < 0.01	
Basketball Throw test	0.77, p < 0.001	0.30, p < 0.05

Note. Significant correlation coefficients was found between the tests

Figure 1: The relationship between basketball throw test and handgrip test scores

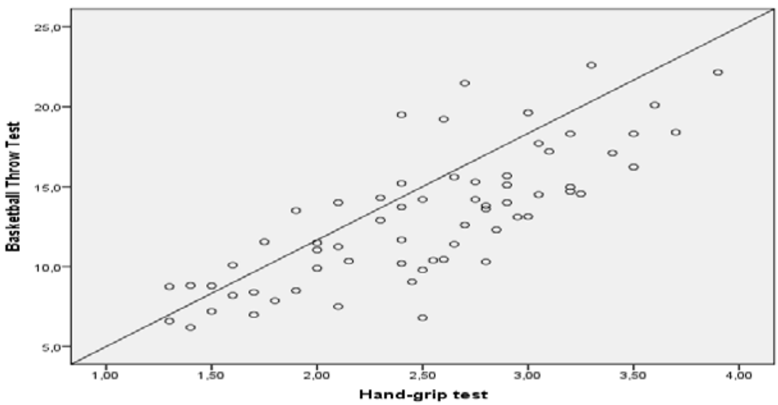

Table 3 The difference analyses between two groups (6 and 10 years old children)
M: meter. Kg: kilogram. BMI: Body Mass Index

	6 years old	10 years old		
	Mean ± SD	Mean ± SD	t-test	p-value
Height (m)	1.30 ± 0.07	1.36 ± 0.08		
Weight (kg)	26.13 ± 4.42	34 ± 5.24		
BMI (kg/m2)	15.19 ± 1.23	18.11 ± 0.81		
Basketball Throw (m)	1.61 ± 0.23	3.41 ± 0.27	-12.64	0.000
Hand-grip (kg)	9.46 ± 2.57	17.84 ± 1.96	-7.13	0.000

III. Discussion

The Basketball Throw test was designed to assess upper-body MS (ACHPER, 2004). To our best knowledge there has been no study conducted to investigate the validity of the Basketball Throw test of primary school children. The gold standard used for muscular strength validation is the 1M (Repetition Maximum test) (Fernandez-Santos et al., 2016). However, we don’t use it because it is difficult especially for novice children in weight lifting; rather we chose the Hand-grip test as the ‘‘criterion’’ measure because it is well known and commonly used measure of upper-body strength or power in children and his reliability, Validity evidence in assessing the upper-shoulder griddle muscular strength were well documented (Fernandez-Santos et al., 2016; Kolimechkov et al., 2020). Participants were tested using a movement that is similar to a chest pass. In our study, the Basketball Throw test obtains a high correlation with the hand-grip test $r = 0.77$, $p < 0.001$. Thus, the basketball throw test is shown a high validity coefficient for assessing the upper-body muscular strength of primary school children. There is also a significant difference in the basketball throw test scores between the 6-year-old group (1.61 ± 0.23) and the 10-year-old group (3.41 ± 0.27), $t = -12.64$, $p < 0.001$ which provide additional evidence of validity based on known-difference evidence between the age groups. Fernandez-Santos and his colleagues analyzed the validity of the Basketball Throw test (overhead throw) in 6 to 12-year-old children using 1RM test as a criterion measure), reporting high validity coefficient ($r = .79$, $p < .01$; $R^2 = .621$) (Fernandez-Santos et al., 2016). This result is similar to those obtains in ours study. A similar test called Medicine Ball Throw test also had been shown to be a valid test to assess upper-body strength in children ($r = .34$, for correlation between test score with stature and body mass) (Davis et al., 2008). Previous studies involving the seated shot put test which (similar to the Baskatball throw test) used as a measure of upper-body power (Mayhew et al., 1992; Salonia et al., 2004; Stockbrugger & Haennel, 2001) . However, this test was investigated athletes participants, not physical education students and some are adolescents. We found a significant relationship between the basketball throw scores and BMI ($r = 0.30$, $p < 0.05$) which indicate that the body composition effect the Basketball throw test scores.

IV. Conclusion

According to the results thought this study, it appears that the Basketball Throw test is a reasonably valid measure of upper-body strength/power in primary school children and is slightly influenced by body composition. It is practical, time-efficient, low cost equipment and funny test (children were asked verbally about the testing experience at the end of each session and they reported that it was funny). We propose to include this test in health related fitness test field-based batteries to assess upper-body muscular strength /power in children. Finally, given the results found in our study in comparison with previous studies, more research about the objectivity, reliability and validity of the Basketball Throw test is needed in particular and of upper-body muscular endurance tests is general and in multiple age groups.

References

ACHPER. (2004). Australian fitness education award: Teacher's handbook and curriculum ideas (2nd ed). The Australian Council of Health Physical Education and Recreation.

Al-Din, St. H., Kamal, H., & Amin, K. M. (2020). The relationship between some morphological measurements and some elements of physical fitness among male Karate Do athletes (15-17) years old. Journal of Science and Technology for Physical and Sports Activities, 17(4), 153–167.

Barker, R. (2004). BTEC National Sport: Sports Development and Fitness Options. Heinemann.

Baumgartner, T. A., & Chung, H. (2001). Confidence limits for intraclass reliability coefficients. Measurement in Physical Education and Exercise Science, 5(3), 179–188.

Baumgartner, T. A., Jackson, A. S., Mahar, M. T., & Rowe, D. A. (2015). Measurement for evaluation in kinesiology(9th ed). Jones & Bartlett Publishers.

Brehm, B. (2014). Psychology of Health and Fitness. F.A. Davis.

Burns, R. D., Hannon, J. C., Allen, B. M., & Brusseau, T. A. (2014). Convergent validity of the one-mile run and PACER VO2max prediction models in middle school students. Sage Open, 4(1), 2158244014525420.

Belaidouni, M., Zidan, h. B., & Bouaziz, M. (2019). The effectiveness of a suggested physical recreation program to improve some physiological variables (body mass index - resting heart rate) in the elderly. Journal of Science and Technology for Physical and Sports Activities, 16(2), 301–318.

Davis, K. L., Kang, M., Boswell, B. B., DuBose, K. D., Altman, S. R., & Binkley, H. M. (2008). Validity and reliability of the medicine ball throw for kindergarten children. The Journal of Strength & Conditioning Research, 22(6), 1958–1963.

Dahoune. O, Benkhaled . H, Taher .T , Ahmed . A. (2018). Assessment of the level of health-related fitness components for secondary school students using a computer program. Journal of Science and Technology for Physical and Sports Activities, 15(5), 83–103.

Djamila. (2020). The effect of special strength training according to the laws of ability and work in some biomechanical variables and the achievement of running 400m for young people. Journal of Science and Technology for Physical and Sports Activities, 17(4), 31–50.

Daho, b. j. (2018). A comparative study of health-related fitness components according to the variables of age group, gender and type of physical sports

activity. Journal of Science and Technology for Physical and Sports Activities, 15(2), 207–222.
España-Romero, V., Ortega, F. B., Vicente-Rodríguez, G., Artero, E. G., Rey, J. P., & Ruiz, J. R. (2010). Elbow position affects handgrip strength in adolescents: Validity and reliability of Jamar, DynEx, and TKK dynamometers. The Journal of Strength & Conditioning Research, 24(1), 272–277.
Fernandez-Santos, J. R., Ruiz, J. R., Gonzalez-Montesinos, J. L., & Castro-Piñero, J. (2016). Reliability and validity of field-based tests to assess upper-body muscular strength in children aged 6-12 years. Pediatric Exercise Science, 28(2), 331–340.
Frontera, W. R., Slovik, D. M., & Dawson, D. M. (2006). Exercise in rehabilitation medicine. Human Kinetics.
Gallahue, D. L., Ozmun, J. C., & Goodway, J. D. (2011). Understanding Motor Development: Infants, Children, Adolescents, Adults (7e édition). McGraw-Hill Higher Education.
Garcia-Hermoso, A., Vegas-Heredia, E. D., Fernández-Vergara, O., Ceballos-Ceballos, R., Andrade-Schnettler, R., Arellano-Ruiz, P., & Ramírez-Vélez, R. (2019). Independent and combined effects of handgrip strength and adherence to a Mediterranean diet on blood pressure in Chilean children. Nutrition, 60, 170–174.
Kolimechkov, S., Castro Piñero, J., Petrov, L., & Alexandrova, A. (2020). The effect of elbow position on the handgrip strength test in children: Validity and reliability of TKK 5101 and DynX dynamometers.
Lotfi, b. p. A., Muhammad, M., & Talib, A. (2019). A comparative study of some motor abilities and body mass index among healthy children with Down syndrome (9-12 years). Journal of Science and Technology for Physical and Sports Activities, 16(2), 187–199.
Mayhew, J. L., Bemben, M. G., & Rohrs, D. M. (1992). Seated shot put as a measure of upper-body power in adolescent wrestlers. Pediatric Exercise Science, 4(1), 78–84.
McManis, B. G., Baumgartner, T. A., & Wuest, D. A. (2000). Objectivity and reliability of the 90 push-up test. Measurement in Physical Education and Exercise Science, 4(1), 57–67.
Morrow Jr, J. R., & Jackson, A. W. (1993). How "significant" is your reliability? Research Quarterly for Exercise and Sport, 64(3), 352–355.
Muyor, J. M., Vaquero-Cristóbal, R., Alacid, F., & López-Miñarro, P. A. (2014). Criterion-related validity of sit-and-reach and toe-touch tests as a measure of

hamstring extensibility in athletes. The Journal of Strength & Conditioning Research, 28(2), 546–555.

Taha, A. (2018). Suggesting a training program for primary school students to improve health-related physical fitness - a field study on some elementary school students in the state of Djelfa in Algeria -. Journal of Science and Technology for Physical and Sports Activities, 15(1), 44–63.

Omar, M. T. A., Alghadir, A., & Al Baker, S. (2015). Norms for hand grip strength in children aged 6–12 years in Saudi Arabia. Developmental Neurorehabilitation, 18(1), 59–64.

Pate, R. R., Burgess, M. L., Woods, J. A., Ross, J. G., & Baumgartner, T. (1993). Validity of field tests of upper-body muscular strength. Research Quarterly for Exercise and Sport, 64(1), 17–24.

Plowman, S. A., & Meredith, M. D. (2013). Fitnessgram/Activitygram reference guide. Dallas, TX: The Cooper Institute, 3, 7–9.

Ramírez-Vélez, R., Peña-Ibagon, J. C., Martínez-Torres, J., Tordecilla-Sanders, A., Correa-Bautista, J. E., Lobelo, F., & García-Hermoso, A. (2017). Handgrip strength cutoff for cardiometabolic risk index among Colombian children and adolescents: The FUPRECOL Study. Scientific Reports, 7(1), 1–7.

Salonia, M. A., Chu, D. A., Cheifetz, P. M., & Freidhoff, G. C. (2004). Upper-body power as measured by medicine-ball throw distance and its relationship to class level among 10-and 11-year-old female participants in club gymnastics. Journal of Strength and Conditioning Research, 18(4), 695–702.

Stockbrugger, B. A., & Haennel, R. G. (2001). Validity and reliability of a medicine ball explosive power test. The Journal of Strength & Conditioning Research, 15(4), 431–438.

Suhaila, A., Faisal, B., & Muhammad, K. (2020). A study of the change of the maximum oxygen consumption and fatigue index during the stages of the sports season among the top male 800m runners. Journal of Science and Technology for Physical and Sports Activities, 17(4), 95–109.

Trossman, P. B., & Li, P.-W. (1989). The effect of the duration of intertrial rest periods on isometric grip strength performance in young adults. The Occupational Therapy Journal of Research, 9(6), 362–378.

Vanhelst, J., Béghin, L., Fardy, P. S., Ulmer, Z., & Czaplicki, G. (2016). Reliability of health-related physical fitness tests in adolescents: The MOVE P rogram. Clinical Physiology and Functional Imaging, 36(2), 106–111.

Woods, J. A., Pate, R. R., & Burgess, M. L. (1992). Correlates to performance on field tests of muscular strength. Pediatric Exercise Science, 4(4), 302–311.