

Reliability and Validity of Mobile Application for Hamstring Muscle Power among Military Cadet

Original Scientific Paper

Training and Testing

Shahrulfadly Rustam¹, Mohar Kassim¹, Jorrye Jakiwa¹, Norhafizah Hamzah¹, Mohd Syrinaz Azli¹ and Siti Azilah Atan¹

¹National Defence University of Malaysia, Defence Fitness Academy, Kuala Lumpur,
Malaysia

Corresponding Author:

S.Rustam

Defence Fitness Academy, National Defence University of Malaysia,

Kem Sungai Besi, 57000, Kuala Lumpur, Malaysia

E-mail: shahrulfadly@upnm.edu.my

Word count: 2998

Abstract word count: 210

Number of Tables: 2

Number of Figures:

ABSTRACT

Mobile learning using information technology elements is facilitating, helping the learning outcomes of a learning process more quickly and effectively especially in physical fitness. **PURPOSE:** The aim of this study is to develop and measure the reliability of mobile application for standing broad jump test physical fitness among Army Cadet Officers of National Defense University of Malaysia (NDUM). **METHODS:** This is a quantitative research using the test-retest method to obtain the reliability value by using mobile application as research instrument. The standing broad jump physical fitness test battery is use to develop mobile application and to measure the reliability of mobile application on the subject fitness. **RESULT:** The findings showed the correlation coefficient between the first test score of the use of mobile application for standing broad jump and the second test score of the use of mobile application for standing broad jump are significant ($r = 0.92$, $n = 30$, $p < 0.001$). The results of the study found that the value of Pearson correlation coefficient for both tests was $r = 0.92$. This shows the reliability of the use of mobile applications for standing broad jump test is high and acceptable. **CONCLUSION:** The implication of this study, the mobile application used is easy to obtain results on the level of physical fitness of muscle power for NDUM cadet officers. Not only that, this mobile application only requires a mobile phone, which is owned by all communities, and it is easy to be implemented anywhere.

Introduction

Physical fitness is a component that is used all the time to carry out an activity and without feeling, tired when maximum energy has been used (Kassim et al., 2018). As such, modern society are now less likely to achieve optimum fitness levels (Kassim et al., 2020). Kassim and Rustam (2021) also state the view that only individuals who involved in sports need to good for a physical fitness is untrue. This is because individuals who are not involved in sports also have to go the physical fitness as a measure to improve the quality of well-being. This is in line with the importance of personal health in the daily life of the individual. Regular physical activity is beneficial for bone and skeletal health, motor skills development and psychosocial as well as cognitive development of individuals. Optimal physical fitness is important in daily life. Through current developments, modern society now tends to achieve optimal levels of fitness (Kassim et al., 2020). Widiyanto and Hartono (2018) mention that, the same goes for military officers who need physical activity training in their daily duties. Physical fitness has an essential role in supporting one's physical activities so that they can carry out their duties optimally. The degree of physical fitness has a linear relationship with the level of achievement, work success, and other physical activities. This is because the intensity of physical training, and injuries associated with military training are high in the military population (Samantha et al., 2015). The performance of military training is a very important thing before performing duties as a military officer. Monitoring the level of physical fitness of the armed forces and security is important in terms of performance, as well as to assess their combat capabilities (Rustam and Kassim, 2018).

Lara et al. (2006) state the muscle power is an explosive force formed through plyometric training. Plyometric training is a type of exercise that combines elements such as muscular endurance, muscle strength and muscle coordination to produce high explosive power. Rustam and Kassim (2018) also support that the muscle power is the result of strong muscle strength that is used as a momentary incentive while performing an activity. It is also associated with performance peak forces associated with explosive movements such as running and jumping as well as can be an important variable related to achievement in a particular exercise. Increased power ability is the ability to develop muscle from the beginning of contraction until it reaches the peak level, which is used as an explosive level of strength.

Jumping activities such as vertical jumps provide a simple method for measuring lower limb force levels and strength reactions that require individuals to use slow and fast muscle shortening cycles (Komi, 2000). In addition, Yuta (2015) state the various events, such as horizontal jumping, vertical jumping and the presence or absence of counter-movement, have been used to study the relationship between jump ability and performance. Some of these jump ability measurement events have been treated as one jump ability without distinction.

The standing broad jump test battery is a physical fitness test used to assess and measure an individual's leg muscle power level. It is one of the important aspects in basic military training to assess the leg muscle power capability of military officers while performing duties as military officers. Generally, military officers need a certain level of fitness to physically meet the demands of war. Military officers are asked to jump, glide, climb, and run from one place to another and carry heavy loads in the end while conducting military missions. Thus, from a military perspective, measurable components of fitness include mobility, strength, endurance, power and flexibility (Roy et al., 2010).

In line with the development of the level of physical fitness that is emphasized at this time is to improve the quality of life the use of information and communication technology (ICT) is the main catalyst to assess the level of physical fitness more effectively. ICT covers all technologies that assist in the delivery of information such as radio, television, mobile phones, computers and the internet. The rapid development of information and communication technology affects almost all aspects of life such as the dissemination of news and the sharing of educational knowledge including the development of personal health. Advances in technology have also changed the way humans learn and work as well as help in managing their daily lives (Sharples, et al., 2000). In addition, Salman and Hashim (2011) said, the global and limitless nature of technology makes it easier for it to continue to grow. Innovation and creativity of researchers have created something that never existed in the past. This is because technology has become a bridge between individual experience and existing knowledge with new knowledge taught and learned through delivery in various mediums such as mobile applications.

The development of technology in the creation of equipment that helps in daily life is further proven through the studies stated here. Ahmad et al. (2005) reported the importance of the use of information and communication technology (ICT)-assisted equipment in teaching and learning.

According to them, ICT helps in realizing effective and efficient teaching as well as attracting educators about positive values in teaching. These positive attitude changes affect the overall effectiveness of teachers' attitudes in the studies they conduct and make the teaching of history subjects more popular and easy to understand. Chen and Kinshuk (2005) found that mobile technology is a mobile media that can be accessed by any individual regardless of time and place. This makes the learning environment more dynamic and provides free access to information. Mobile or mobile learning using information technology elements is facilitating and helping the learning outcomes of a learning process more quickly and effectively. The success of the use of mobile equipment is driven by the construction of a special program that supports the process of an activity to be more interactive to attract individuals so that the experience of carrying out activities, especially in the aspect of physical fitness can be felt and enjoyed together meaningfully. This study also acknowledges that platform applications such as Android, iOS, and Blackberry as applications that are increasingly popular and needed by everyone, especially individuals who are easily attracted to the application offering in search of information and information.

As predicted based on current technological developments, various equipment were created to facilitate daily life. Smartphones are now a much-needed communication tool by many people, especially the young (Shanmugapriya and Tamilarasia, 2011). The current situation shows the penetration rate of mobile technology, especially smartphone technology is very sudden. Sarwar and Soomro (2013) mention this situation is also supported by internet infrastructure facilities for fast internet access and Wi-Fi facilities in most places visited by the public. People are attracted to be part of digital citizens by owning smartphones. Apart from infrastructure facilities, the introduction of user-friendly mobile applications also plays a role in increasing the use of smartphones. This smartphone is also now created not only to meet basic needs such as the use of social applications, but also to be very user friendly and anyone can use it even though their ICT knowledge is very limited.

This study was conducted to evaluate the reliability of the use of mobile applications involving leg muscle power components. Standing broad jump fitness test is a test battery evaluated in this study to measure the reliability of the use of this mobile application to military cadet officers. A test result obtained from a repeated test provides a consistent result and have high reliability. Even tests that have high reliability will produce stable and accurate data. The reliability of a test battery is required to

identify the level of suitability of the test battery on a group of study subjects. Although previous researchers have conducted reliability studies on standing broad jump test batteries, the reliability of the use of mobile application for standing broad jump test on military officers has not been done. This is because choosing the most accurate measurement tool depends on a variety of factors including the population of interest, the purpose of the study, the required outcome variables (Chinapaw, et al., 2010) (Ridgers, et al., 2012), and most importantly the validity and reliability of the instrument (Warren, et al., 2010). Therefore, this study involved military cadet officers at NDUM as the main subject. The objective for this study is to evaluate the reliability of mobile application for standing broad jump test.

Method

Materials and Procedures

This study is a quantitative research in the form of quasi-experimental methods with field studies. According to Ahmad and Gunathevan (2015), this quasi-experimental method is a method in which data are obtained from tests performed in field studies (Collins, 2007). This study uses the test-retest method to obtain the reliability value of the test by using mobile application as a research instrument. The reliability of the test is to measure the consistency of the reliability of mobile applications test measured over time. In other words, twice the same test is given to the same person at different times to see the score obtained and the two scores are linked to obtain the reliability of the test.

Having good test reliability for test retest indicates the internal validity of the test and ensures that the measurements obtained in one test session are indicative of stability over time. According Giavarina (2015), often reliability tests of retest tests are performed at two times in a short period of time to reduce conclusions due to age-related performance changes compared to poor stability. Giavarina (2015) also added, without good reliability, it is difficult to believe that the data provided by the measurement is an accurate picture of the performance of the subject and not due to irrelevant things during the test such as environmental, psychological or methodological processes. Therefore, the test retest method is a method used to see the reliability of a physical fitness instrument especially for determine the level of hamstring muscle power. This test retest method is also to see the consistency of

the instrument so that it can be used by all individuals who want to maintain their level of physical fitness muscle power.

The data of this study involved a total of 30 NDUM Army Cadets Officers aged 19 to 21 years who were used as the study sample. The sample of this study was selected using the purposive sampling method.

Test Procedures

This study uses a total of (N = 30) NDUM Army Cadets Officers aged 19 to 21 years. This study was conducted by test retest to obtain the reliability of the mobile application of standing broad jump test. At the initial stage to conduct the study, the subject is given a description of the standing broad jump test with the demonstration method. The description of the test conducted involves the standing broad jump test procedure. After the explanation and demonstration are carried out the subject is given the opportunity to try the standing broad jump activity before the score test is taken. Score test were taken using by an android application that develop to assess the level of physical fitness performance of the sample.

Standing Broad Jump Test. The subject stands behind the starting line. Both hands of the subject are swung forward and backward and the knees are bent to gain momentum to make the jump. The jump is done by swinging both hands forward and the subject straightens his knees. The subject should perform a forward jump as far as possible and land with both feet. Two attempts are given and the longest jump is counted as a test score. To obtain the jump distance reading, the jump score is taken into account on any part of the back heel during landing and the distance score is taken based on the best jump distance. The measure of the farthest distance is calculated in the nearest centimeter count. All the jump distance data obtained are entered into the mobile application to evaluate and obtain the physical fitness level of the sample.

Mobile Application. Mobile application is an instrument to assess the level of individual's physical fitness, especially in determining the level of physical fitness of hamstring muscle power. All raw scores obtained during the standing broad jump test while physical training are carried out, will be entered into the mobile application. The score will be analyzed in the mobile application to get the results of the level of individual's physical fitness immediately.

A test-retest method was implemented to assess the reliability of the mobile application for standing broad jump test against NDUM Army Cadet Officers. This standing broad jump test score is taken twice as many test procedures are performed. On the first day the subject performed a standing broad jump test and the test score has been recorded in the mobile application. On the second day the subject undergoes a recovery process because standing broad jump test is a test that can result in injury if there is no recovery process. On the third day, the subject performed a broad jump test to record the second jump score and recorded in the mobile application.

Questionnaires were used as research instruments to assess the reliability of mobile applications through the level of consent of the sample using mobile applications in obtaining results on the level of physical fitness of the sample muscle power. Questionnaires are given after each test is done on the first test and the second test.

Data Analysis

This study uses the Pearson correlation coefficient method as a data analysis method. This method is used to analyze the data through the method of test retest performed on the subject to obtain the reliability of the mobile application for the standing broad jump test. Correlation coefficient (r) is used to answer the relationship question, which is to measure the level of relationship strength.

Collins (2007) states that instrument reliability is calculated by measuring subjects at two different times on the same instrument and then calculating correlations to obtain test data results. If the correlation is large, it is considered proof that the reliability of the test is good. However, test-retest procedures need to assume that the measured construct does not change over time (Collins, 2007). This indicates that the procedures during test one and test two should be the same and parallel on both. Collins (2007) also added that if the subjects in the study undergo changes in the test construct at different rates between the first and second tests, the correlation between the two tests would be low even if the measurement instrument is very accurate.

Results

All data obtained from the test retest of use of mobile applications for standing broad jump test were collected and processed using windows SPSS version 20 software program. The data obtained were analyzed to obtain the mean results and standard deviation of each test performed. Not only that, the

result of this study is also to obtain the value of the correlation coefficient (r) between test one and test two through the use of mobile application of standing broad jump test. It also to see the strength of the relationship between the two tests using mobile application and measure the reliability of mobile application for standing broad jump test.

	Mean	Standard Deviation	N
First test mobile application for Standing Broad Jump	7.507	1.7235	30
Second test mobile application for Standing Broad Jump	7.622	1.4346	30

Table 1. Test retest of mobile application

The result as shown (table 1) of descriptive statistical that showed the test retest for both standing broad jump tests by using mobile applications. The result found that the mean and standard deviation for the first test of mobile application use for standing broad jump test was $m= 7.507$, $SD=1.7235$, while the mean and standard deviation for the second test of mobile application use for standing broad jump test was $m=7.622$, $SD=1.4346$. The results above show that there is a mean difference between the first test and the second test for the use of mobile applications for standing broad jump, that is, the second test of using mobile applications for standing broad jump through test retest found higher mean results than the first test results. This indicates that there is an improvement in the tests performed by the study subject through test procedures that are well administered by the tester.

		First test mobile application for Standing Broad Jump	Second test mobile application for Standing Broad Jump
First test	Pearson Correlation	1	.927**
mobile	Sig. (2-tailed)		.000
application for	Sum of Squares and	86.146	66.462
Standing Broad	Cross-products		
Jump	Covariance	2.971	2.292
	N	30	30
Second test	Pearson	.927**	1
mobile	Correlation		
application for	Sig. (2-tailed)	.000	
Standing Broad	Sum of Squares and	66.462	59.688
Jump	Cross-products		
	Covariance	2.292	2.058
	N	30	30

** . Correlation is significant at the 0.01 level (2-tailed).

Table 2. Reliability of mobile application

Table 2 shows the result values of the correlation coefficient for the first test and the second test for the use of mobile applications for standing broad jump tests performed on (N = 30) study subjects among NDUM Army Cadet Officers. Based on the SPSS procedure, the output below shows the correlation coefficient between the first test score of the use of mobile application for standing broad jump and the second test score of the use of mobile application for standing broad jump is significant i.e. ($r = 0.92$, $n = 30$, $p < 0.001$). The results of the study found that the value of Pearson correlation coefficient for both tests was $r = 0.92$. This shows the reliability of the use of mobile applications for standing broad jump test is high and acceptable.

Discussion

The main purpose of this study is to investigate the value of test reliability of the use of mobile applications to test muscle power on NDUM Army Cadets Officers aged 19 to 21 years. The physical fitness test battery selected in this test is a standing broad jump test battery. Apart from that, the selection of this test battery is because it is easy to do and does not require complex technical equipment. In this case, the selected test battery is to test the muscular power capabilities of NDUM Army Cadets Officers and monitor their fitness level from time to time. Mobile applications are used as a testing tool to assess and obtain the level of physical fitness of muscle power more easily and quickly. The test scores that included in the built-in mobile application can provide easy and quick results on the level of physical fitness of the muscle power of the cadet officers involved in the study.

The validity and reliability of the instrument is very important to maintain the accuracy of the instrument from being exposed to defects. The higher the value and level of validity and reliability of the instrument the more accurate the data that will be obtained to produce a good and quality study (Ahmad, 2015). Wheelan (2014) also states the reliability and validity are measurements that refer to the stability and consistency of a research tool whether it can answer the research questions that have been constructed.

Ahmad (2015) explained that the reliability of a test should be obtained first before checking the validity of the test. The objectivity of a test is also closely related to reliability. Thus, the relationship between objectivity and validity is the same as the relationship between reliability and validity. Objectivity and reliability are a prerequisite to test validity.

Wheelan (2014) states that the correlation coefficient for two data sets is one of the most commonly used methods to find the correlation between the two tests. The test coefficient of reliability is also referred to between values 0 and 1. Wheelan (2014) also lists the values of reliability coefficient i.e. value 1 has perfect coefficient of reliability, value over 0.9 has excellent coefficient of reliability, value 0.8 to 0.9 have good reliability coefficients, values 0.7 to 0.8 have acceptable reliability coefficients, 0.6 to 0.7 values have questionable reliability coefficients, 0.5 to 0.6 values have weak reliability coefficients, values less than 0.5 have unreliable reliability coefficients accepted and the value of 0 has no reliability.

Portney (2000), has also outlined some guidelines for the classification of correlation coefficients namely; less than 0.50 has a weak correlation, 0.50 to 0.75 has a moderate correlation, 0.75 to 0.90 has a good correlation and more than 0.90 has a perfect correlation.

The results obtained from this study show that the reliability value for the use of smart applications for muscle power testing among NDUM Army cadet officers is high. The value of the correlation coefficient obtained in this study shows the value ($r = 0.92$). The value of the correlation coefficient obtained in this study is in line with the guidelines from Whelan (2014) who stated that the value of the correlation coefficient exceeding 0.90 has an excellent reliability coefficient. Similarly, Portney (2000) who stated that the correlation value above 0.90 is perfect has also supported this. For Ahmad (2015), the value of the correlation coefficient in the field of Physical Education and Sports Science adopts the test correlation value between exceeding 0.80. Therefore, the reliability of the use of mobile applications for standing broad jump tests to test the muscular power of NDUM Army Cadets officers is high and very suitable for use in assessing the physical fitness level of subjects aged 19 to 21 years.

The results obtained in this study show that the mobile application of standing broad jump fitness test has gained high reliability to test the muscular power of NDUM Army Cadets Officers. The application used is easy to obtain results on the level of physical fitness of muscle power for NDUM cadet officers. Not only that, this application only requires a mobile phone that is owned by all communities and it is easy to be implemented anywhere. From a practical point of view, the test batteries implemented are valid because of their high reliability. From the aspect of test administration, the test procedures are easy to be understood by the subject and the demonstration done makes it easier for the subject to better understand the standing jump test procedure.

Acknowledgments

First of all, the authors wish appreciation especially to National Defense University, Research and Innovation Division of the National Defense University of Malaysia and Defense Fitness Academy for giving the opportunity to conduct and publish the result of this research under National Defense University of Malaysia research grant UPNM/2020/GPJP/SSK/2. Special thanks go to Army Cadets

Officers of National Defense University of Malaysia for supporting the studies of the authors that enabled them to conduct this research.

References

1. Ahmad H. & Gunathevan. (2015). 900 push-up test norms for sport science students Sultan Idris Education University. *International Journal of Development and Emerging Economics*, 3, 1- 9.
2. Ahmad, H. (2015). *Pengujian Pengukuran dan Penilaian Pendidikan Jasmani*. Dubook Press Sdn.Bhd, Selangor.
3. Ahmad, Ibrahim and Aris, Baharuddin (2005). *Pembangunan Protaip Perisian Multimedia Interaktif Sistem Komputer Dan Aplikasinya Berasaskan Pendekatan Pembelajaran Berasaskan Masalah*. Masters thesis, Universiti Teknologi Malaysia.
4. Chen J. & Kinshuk (2005). Mobile Technology in Educational Services. *Journal of Educational Multimedia and Hypermedia*.14 (1), 91 – 109.
5. Chinapaw, M., Mokkink, L., Van Poppel, M., Van Mechelen, W., & Terwee (2010). Physical activity questionnaires for youth. *Sports Medicine*, 40(7), 539– 563. Doi: [10.2165/11530770-000000000-00000](https://doi.org/10.2165/11530770-000000000-00000), 2010.
6. Collins, L.M. (2007). *Research Design and Methods*. Encyclopedia of Gerontology. 2nd ed. Academic Press, Amsterdam:Boston.
7. Giavarina, D. (2015). Understanding Bland Altman analysis. *Lessons biostat*. 25, 141–151. Doi: [10.11613/BM.2015.015](https://doi.org/10.11613/BM.2015.015).
8. Kassim.M., Zaidi. A.M.A & Mokhtar.R.S (2018). Development of Android Application for Measuring Cardiovascular Endurance Fitness for Military Cadet Officers. IOP Conference Series: *Journal of Physics: Conf. Series* 1020.
9. Kassim M., Othman N. & Ujang E. (2020). The Level of Physical Fitness among First Year Female Students in National Defence University of Malaysia. IOP Conf. Series: *Journal of Physics: Conference Series* 1529. Doi:[10.1088/1742-6596/1529/2/022072](https://doi.org/10.1088/1742-6596/1529/2/022072).
10. Kassim.M. & Rustam.S (2020). Measuring Physical Fitness for Military Cadets Officers. ICICT 2020: Proceedings of 5th International Congress on Information and Communication Technology pp554-561. *Advances in Intelligent Systems and Computing*. Book series: AISC .vol: 1183.
11. Kassim, M. & Rustam, S. (2021). Physical Fitness Norms of Upper Body among Army Reserve Officer Training Unit (ROTU). *AIP conference proceedings*, 2401, 020027.
12. Komi, P. V. (2000). Stretch-shortening cycle: A powerful model to study normal and fatigued muscle. *Journal of Biomechanics*, 33(10), 1197–1206. Doi:[10.1016/S0021-9290\(00\)00064-6](https://doi.org/10.1016/S0021-9290(00)00064-6).
13. Lara A.J, Abian J, Alegre L.M, Linares L & Aguado X.(2006). Jump tests on a force platform for applicants to a sports science degree. *J Hum Mov Stud*, 50, 133-148.
14. Portney LG, W.M. (2000). *Foundations of clinical research: applications to practice*. Prentice Hall, New Jersey.

15. Rustam S. & Kassim M. (2018). Physical Fitness Index for Assess Fitness Speed Among Army Reserve Officer Training Unit Cadet in Malaysia. IOP Conf. Series: *Journal of Physics: Conf. Series* 1020. Doi.org/ :10.1088/1742-6596/1020/1/012009.
16. Roy T.C, Springer B.A, McNulty V & Butler N.L. (2010). Physical fitness. *Mil Med.* 175(8).
17. Ridgers, N., Timperio, A., Crawford, D., & Salmon, J. (2012). Validity of a brief self-report instrument for assessing compliance with physical activity guidelines amongst adolescents. *Journal of Science and Medicine in Sport*, 15(2), 136–14. Doi: [10.1016/j.jsams.2011.09.003](https://doi.org/10.1016/j.jsams.2011.09.003).
18. Sharples, M. (2000). The Design of Personal Mobile Technologies for Lifelong Learning. *Computers & Education*, 177-193.
19. Salman, A. and Hasim, M.S. (2011). Internet Usage in a Malaysian Sub-Urban Community: A Study of Diffusion of ICT Innovation. *The Innovation Journal: The Public Sector Innovation Journal*, 16(2).
20. Shanmugapriya M. dan Tamilarasia, A. (2011). Designing an m-learning application for ubiquitous learning environment in the android based mobile devices using web services. *Indian Journal of Computer Science and Engineering* 22 – 30.
21. Sarwar M. and Soomro T.R (2013). Impact of Smartphone's on Society. *European Journal of Scientific Research*, 98 (2), 216-226.
22. Safrit, M. J. (1990). Introduction to measurement in physical education and exercise science. (2nd ed.), MO: Times Mirror/Mosby, St. Louis.
23. Samantha A. Scott, Janet E. Simon, Barbara Van Der Pol & Carrie L. Docherty. (2015). Risk Factors for Sustaining a Lower Extremity Injury in an Army Reserve Officer Training Corps Cadet Population. *MILITARY MEDICINE*, 180, 8:910.
24. Widiyanto, & Hartono, S. (2018). The effects of hyperbaric oxygen and active recovery on lactate removal and fatigue index. *Sport Mont*, 16(3), 15–18. doi:10.26773/smj.181003
25. Warren, J. M., Ekelund,U., Besson, H.,Mezzani, A., Geladas,N., & Vanhees, L. (2010). Assessment of physical activity – a review of methodologies with reference to epidemiological research: A report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation. *European Journal of Cardiovascular Prevention and Rehabilitation*, 17(2), 127–139. Doi:[10.1097/ HJR.0b013e32832ed875](https://doi.org/10.1097/HJR.0b013e32832ed875).
26. Wheelan, C. (2014). [Naked Statistics](#). W. W. Norton & Company, London.
27. Yuta Takanashi (2021). The Relationship between Jump Ability and Athletic Performance in Athletic Throwers. *Sport Mont*, 19(1), 71-76. DOI 10.26773/smj.210215