THE RELIABILITY OF PUSH-UP ANDROID SYSTEM IN MEASURING PHYSICAL FITNESS INDEX AMONG MILITARY CADET OFFICERS

SHAHRULFADLY RUSTAM, JORRYE JAKIWA, SITI AZILAH ATAN, NORHAFIZAH HAMZAH, MOHD SYRINAZ AZLI

Defense Fitness Academy, National Defense University of Malaysia, Kuala Lumpur Malaysia
shahrulfadly@upnm.edu.my

ABSTRACT

The aim of this study were, firstly, to develop an android system of push up Physical Fitness Index (PFI) and secondly, to measure the reliability of application of the android system for push up test among military cadet officers. Thirty (N=30; male and female) participants from Military Cadet Officers of National Defense University of Malaysia (NDUM) volunteered to participate in this study. The process starts with the development of the mobile application by using a software. This application allows analysis to be undertaken immediately to measure the PFI in physical fitness testing. To measure the reliability of the application, the participants attended three sessions. This included familiarization of the Push up test procedures and two full trials using the android system that separated by 7 days. Participants performed push up in a straight position from the knees to the shoulders (modified version used for female), lower the upper body until elbows bend to 90 degrees and push back up to the start position. The participants required to complete as many repetitions within 60 seconds. Data were gathered in the application that provides immediate scores for PFI for each participant. The data was analyzed using a Pearson correlation to measure the reliability of the mobile android system application use in fitness test. The results showed significantly high correlation between trials score of the android system application for Push up test ($r = 0.91$, $n = 30$, $p < 0.001$). This indicates that the android system applications for the push up test is reliable. In conclusion, the android system application appears to be reliable and easy to be used and accessible to measure the PFI in a military fitness-testing context.

Keywords: Mobile Application, Test-Retest, Strength Test, Physical Fitness, Military

1. INTRODUCTION

Regular physical activity is beneficial for overall health. It helps to decrease the risk of diseases like diabetes, cancer as well as improving motor skills development and cognitive function of individuals (1,2). Therefore, optimal physical fitness is important in daily life. In recent years, there has been increasing interest in fitness and modern society is now more aware of the benefits of being physically fit and tends to achieve optimal levels of fitness (3,4). On the other hand, physical fitness is a basic requirement that needed in military officers as they expected to meet the physical demands of any combat or duty ready and be productive in their jobs (5,6). Physical fitness in the military defined as the ability to carry out tasks to optimal performance without undue fatigue and free from any injuries (7). Therefore, military officers need to undergo physical testing constantly to ensure that they are physically fit and may cope with the physiological demand of their job (8). Physical strength and endurance are highly emphasized in military training. Typically, the military physical fitness test was designed to test the muscular strength, endurance and cardiorespiratory fitness consisting a test like push up test, sit up and 2.4 km run (5). This provides information either the military cadet officers are competent across several fitness components.

Recent development of technology has assisted in various ways in physical testing (7,9). For instance, the wearable devices of global positioning system (GPS) has assisted in analysis of match activities, collected data such total distance covered, maximum peak speed, number of sprints, acceleration, heart rate data and percentage of time spent in each match running intensities (10). The GPS technology provides more comprehensive, accurate and automated analysis by using a software compared to the traditional notational analysis method (11). Currently, more and more health and fitness mobile applications are available and it was reported that over half of smartphone users have downloaded such applications (12–14). The use of such technology like Fitness Trackers, Runkeeper, Healthify Me provides simple, meaningful data to users and provide tracking and monitoring physical activity in a more convenient way.

Nevertheless, the use of technology in physical activity within the military context is still lacking especially in Malaysia (6,7). There might be a several reasons such as unavailability of the technology that designed specifically for military, previous applications were designed for individual setting and lack of applications that developed for fitness testing (7). Considering, there are few common fitness components in a military fitness test such as push-up, sits-up, standing broad jump, flexibility and cardiovascular endurance (5,6) processing a big pool of data is challenging. Previously, physical fitness testing in the military has been conducted in traditional ways that involve pen and paper, and need to be key in manually into the computer. These data used to highlight individual strengths and weaknesses or to see the effectiveness of a training programme. However, this method is time-consuming and especially when involved a large group of officers (15,16). To bridge the gap between military and emerging technology such a mobile application is strongly recommended and will help in gathering big data as well as the analysis will be easier and accurate.

A push up test is a basic fitness test used by military to assess upper body strength and endurance. Upper body strength is essential for military task, such as carrying back pack or weapons with ease and without risking for injuries (5). Therefore, the aim of this current study was to develop an application of android system for push up Physical Fitness Index (PFI) and secondly, to measure the reliability of application of the android system for push up test among military cadet officers. This study uses the test-retest method to obtain the reliability value of the test of android system application. The reliability of the test is to measure the consistency of the reliability of android system applications test measured over time. This indicate the consistency and usefulness of the mobile application.

2. METHODS

2.1 Participants

A total of thirty (N = 30) from Reserve Officer Training Unit (ROTU) NDUM Military Cadet Officers aged 19 to 21 years (letak mean +sd for age, height and weight) participated in the study. An informed consent signed by the participants prior to participation in the study. This study was approved by the institutional ethics commitee.

2.2 Study Design

A quasi-experimental design was used for this study. The mobile application was developed by using a basic android system. To measure the reliability of the application, the participants attended three session; one to familiarise them with the procedures and completed two push up test on separate occasions to determine the reproducibility of the mobile application. After the explanation and demonstration is carried out, the participants were given the opportunity to try the push-up before the score test is taken. Score test were taken using by a android application that develope to assess the level of physical fitness performance of the sample. A test-retest method was implemented to assess the reliability of the application of android system for push-up test against Military Cadet Officers. On the first day the participant performed a push-up test and the test score was recorded in the android system. On the second day, the participant again performed a push-up test to record the second push-up score and recorded in the android system.

Questionnaires were also used (17,18) to assess the reliability of android system through the level of consent of the sample using android system in obtaining results on the level of physical fitness of the sample hand strength. Questionnaires are given after each test is done on the first test and the second test.

2.3 Test Procedure

Push-up Test. The participant was in a forward support position with hands straight down. Palms on the floor. Legs straight back. An assistant will be in front and place a hand under the participant's forehead. The participant lowered the body by bending the elbow 90 ° degrees until the forehead touched the assistant's hand. The participant pushed the body upwards until the hands were straight. Repeat the action for 60 seconds by doing as many push up as possible. The number of repetitions will be taken after the 60 second period has expired. Only TWO attempts are allowed.

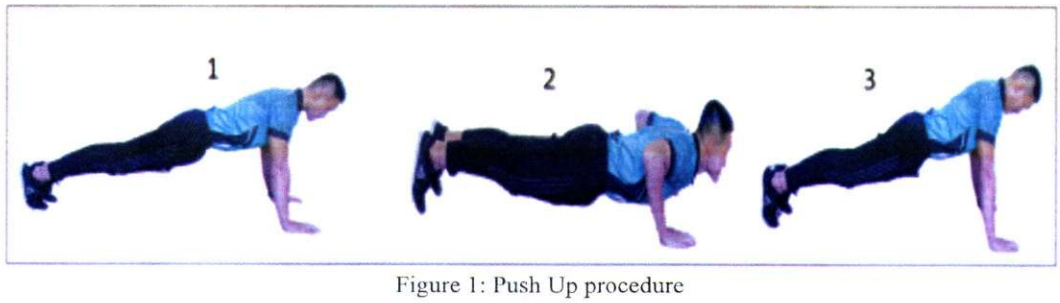

Figure 1: Push Up procedure

2.4 Mobile Application

This push up mobile application is an instrument to assess one component in physical fitness, especially in determining the upper body strength. All raw scores obtained during the push up test, will be entered into the mobile application. The score will be analyzed and the results of the level of individual's physical fitness appeared immediately. Figure 2 illustrate the icon of push up apps use in mobile phone or device that uses the Android system. To start use the application, press clicked and follow all the instructions required.

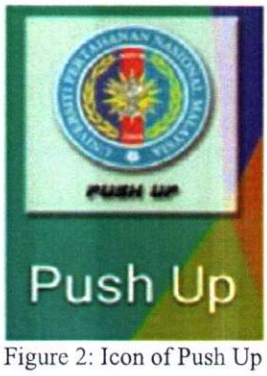

Figure 2: Icon of Push Up

Click the display Icon after the participants have completed push up training. Fill in the required information such as name, identity card number, age and the repetition of push up. Then, click the submit icon to obtain result about the level of individual upper body strength.

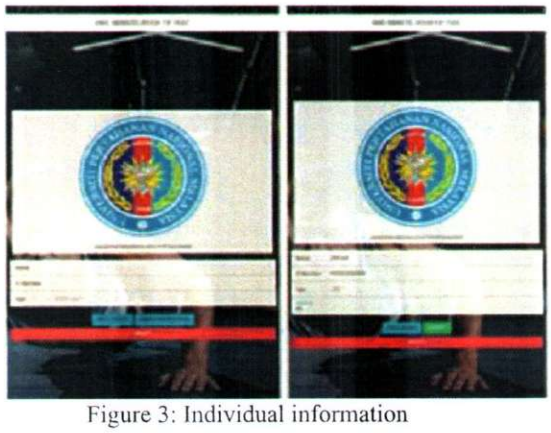

Figure 3: Individual information

Once the submit icon is clicked, the result about the fitness level of their upper body strength appeared immediately. Information of fitness levels will be displayed in the result section.

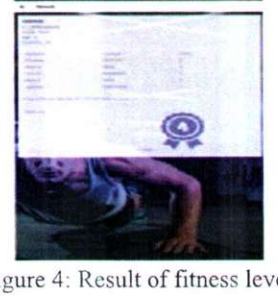

Figure 4: Result of fitness level

2.5 Data Analysis

Data are presented as the means ± standard deviation. Pearson's product movement correlation (r) was used to assess the reliability of the mobile application. The Pearson product movement correlation was used to assess reliability between scores and is a common technique for assessing reliability (19). Test-retest reliability coefficients (also called coefficients of stability) vary between 0 and 1, where 1: perfect reliability, ≥ 0.9: excellent reliability, ≥ 0.8 < 0.9: good reliability, ≥ 0.7 < 0.8: acceptable reliability, ≥ 0.6 < 0.7: questionable reliability, ≥ 0.5 < 0.6: poor reliability, < 0.5: unacceptable reliability and 0: no reliability. All statistical analyses were performed using SPSS software (version 21.0, SPSS inc, Chicago, IL) with the level of significance set at $p \leq 0.05$.

3. RESULT

Table 1: Descriptive Statistic

	Mean	Standard Deviation	N
First test application of android system for Push Up	42.97	8.442	30
Second test application of android system for Push Up	45.67	7.508	30

Table 1 showed the result of descriptive statistical results test retest for both push up tests by using android system. The mean and standard deviation for the first test of application of android system use for push up test was m= 42.97, sd=8.442, while the mean and standard deviation for the second test of application of android system use for push up test was m=45.67, sd=7.508.

Table 2: Pearson Correlation

		First test application of android system for Push Up	Second test application of android system for Push Up
First test application of android system for Push Up	Pearson Correlation	1	.919**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	2066.967	1688.667
	Covariance	71.275	58.230
	N	30	30
Second test application of android system for Push Up	Pearson Correlation	.919**	1
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	1688.667	1634.667
	Covariance	58.230	56.368
	N	30	30

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

Table 2 showed the values of the correlation coefficient between the first and the second test of the used of android system for push up tests. There were a significant different in correlation coefficient between the two test i.e. ($r = 0.91$, n = 30, $p < 0.001$). These showed that the value of Pearson correlation coefficient for both tests was $r = 0.91$ and the reliability of the use of android system for push up test is high and acceptable.

3.1. Data of Push Up Physical Fitness Index (PFI) for male and female age 19 to 21 years old – Suggest new table as below.

Table 3: Push Up Physical Fitness Index (PFI) for male and female age 19 to 21 years old

Age	Category	Male	Female	Score
		Repetition		
19 years old	Excellent	> 60	> 35	5
	Good	47-59	30-34	4
	Fair	33-46	20-29	3
	Poor	20-32	19-23	2
	Very poor	19 >	18 >	1
20 years old	Excellent	> 62	> 38	5
	Good	52-61	29-37	4
	Fair	42-51	20-28	3
	Poor	33-41	11-19	2
	Very poor	32 >	10 >	1
21 years old	Excellent	> 70	> 41	5
	Good	60-69	33-40	4
	Fair	51-59	26-32	3
	Poor	42-50	19-25	2
	Very poor	41 >	18 >	1

Table 3 showed the actual PFI based on the push up test results between the age and gender. There are 5 classifications were used to characterize the evaluation in the actual PFI of physical fitness based on their repetition with the score of 5 being the highest to 1 being the lowest [e.g., Excellent (5), Good (4), Fair (3), Poor (2), and Very Poor (1)]. Based on the results, there was some changes in the repetition between the gender according to the aged of the participants. As showed, the male participant would be categorized as excellent if they performed > 60 repetitions of push up for 19 years old, > 62 repetitions of push up for 20 years old and > 70 repetitions of push up for 21 years old. In contrast, the push up performance among male participant would be categorized as very poor if they performed < 19 repetitions for 19 years old, < 32 repetitions for 20 years old and < 41 repetitions for 21 years old. For female participant, the push up repetition categorized as excellent if they performed > 35 repetitions for 19 years old, > 38 repetitions for 20 years old and > 41 repetitions for 21 years old. While, the female participant categorized as very poor if they performed < 18 repetitions of push up for 19 years old, < 10 repetitions of push up for 20 years old and < 18 repetitions of push up for 21 years old.

4. DISCUSSION

The main purpose of this study was to investigated the value of test reliability of the use of android system applications to test hand strength on Military Cadet Officers aged between 19 to 21 years old. The physical fitness test battery that were selected was a push-up test (to test hand strength) since it is easy to do and does not require complex technical equipment. Mobile applications with built-in android system that were used as a testing tool provide a quick result on the hand strength of the Military Cadet Officers that were involved in this study.

The results obtained from this study showed that the reliability value for the use of android system for hand strength testing among NDUM Military Cadet Officers is high. The value of the correlation coefficient attained in this study shows the *r* value is 0.91. 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 (20). The value of the correlation coefficient obtained in this study is in line with the guidelines from (21) who stated that the value of the correlation coefficient exceeding 0.90 has an excellent reliability coefficient. Reliability and validity are measures that refer to the stability and consistency of a research tool whether it can answer the research questions that have been constructed (22). Wheelan (21) 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 as stability coefficient that is it differs between values 0 and 1. Wheelan (21)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.

Similarly, Safrit (16) explained that the value of the reliability coefficient exceeding 0.90 is very appropriate. This is also supported by Portney (23) who stated that the correlation value above 0.90 is perfect. Portney (23), 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.

According to Ahmad (15), 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 android system for push-up to test the hand strength of NDUM Military Cadet Officers is high and very suitable for use in assessing the physical fitness level of participants aged 19 to 21 years. Ahmad (15) 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.

5. CONCLUSION

In conclusion, from the results obtained in this study, it showed that the mobile application of push-up fitness test has gained high reliability to test the hand strength among NDUM Military Cadet Officers. The used of this application can easily obtained results quick on the level of physical fitness of hand strength for NDUM Military Cadet Officers. Furthermore, this application required a mobile phone that mostly owned by all community and it is easy to implement anywhere. From the practical point of view, the push up test procedure are easy to demonstrated and understand by the participant.

For sports practitioners or sports coaches, the understanding reliability and validity of the test is very important to determine the objective of a test being implemented. It is also needed to evaluate performance as well as plan intervention programs within the training program. Knowledge of reliability will give an idea of the appropriateness of the results obtained in the literature. In fact, it is also necessary to

calculate the measurement of a well-planned study sample and should obtain accuracy during the measurement. This is because the less the measurement, the larger the sample size required to have sufficient statistical strength to see a significant effect.

6. ACKNOWLEDGEMENTS

We would like to thank the NDUM Military Cadet Officers who participated in the study. This study was fully supported by a research grant UPNM/2020/GPJP/SSK/2 from Research and Innovation Division, National Defense University of Malaysia. The authors wish to thank the Research and Innovation Division and Defense Fitness Academy for the support throughout this study.

REFERENCESS

ADDIN Mendeley Bibliography CSL_BIBLIOGRAPHY 1. Jakiwa J, K. Suppiah P. Perbezaan tahap prestasi motor kanak-kanak berdasarkan etnik dan umur kronologi. Malaysian J Movement, Heal Exerc. 2020 Jan 1;9(1).

2. Azli MS, Kassim M, Jakiwa J, Atan SA, Khairul Ikram EH. The effect of amplitude (response complexity) in choice reaction time. 2019 Movement, Heal Exerc Conf Int Sport Sci Conf. 2020 Jan 1;54–63.
3. Kassim M, Othman N, Ujang E. The Level of Physical Fitness among First Year Female Students in National Defence University of Malaysia. In: Journal of Physics: Conference Series. Institute of Physics Publishing; 2020.
4. Jakiwa J, Atan SA, Azli MS, Rustam S, Hamzah N, Zainuddin AA. The Level of Sports Participation and Academic Success among Malaysian Student-Athletes. Int J Learn Teach Educ Res. 2022;21(6):122–37.
5. Jakiwa J, Azli MS, Zainuddin AA, Atan SA. Time spent in physical activity and abdominal muscle endurance level between cadets and civilian students of national defense university of Malaysia. J Mil Med. 2020 Oct 1;22(8):873–82.
6. Rustam S, Kassim M. Physical Fitness Index for Assess Fitness Speed Among Army Reserve Officer Training Unit Cadet in Malaysia. J Phys Conf Ser [Internet]. 2018 May 1 [cited 2022 Sep 28];1020(1):012009. Available from: https://iopscience.iop.org/article/10.1088/1742-6596/1020/1/012009
7. Kassim M, Ahmad Zaidi AM, Mokhtar RS. Development of Android Application for Measuring Cardiovascular Endurance Fitness for Military Cadet Officers. In: Journal of Physics: Conference Series [Internet]. Institute of Physics Publishing; 2018 [cited 2021 Mar 8]. p. 12008. Available from: https://iopscience.iop.org/article/10.1088/1742-6596/1020/1/012008
8. Scott SA, Simon JE, Van Der Pol B, Docherty CL. Risk Factors for Sustaining a Lower Extremity Injury in an Army Reserve Officer Training Corps Cadet Population. Mil Med [Internet]. 2015 Aug 1 [cited 2022 Sep 28];180(8):910–6. Available from: https://pubmed.ncbi.nlm.nih.gov/26226535/
9. Atan SA, Kassim M. Development of a Soccer-Specific Running Protocol for Young Soccer Players. In: Hassan MHA, Che Muhamed AM, Mohd Ali NF, Lian DKC, Yee KL, Safii NS, et al., editors. Enhancing Health and Sports Performance by Design. Singapore: Springer Singapore; 2020. p. 100–13.
10. Atan SA, Kassim M. Young football players are not miniature adults; Do young athletes need sports drinks?: A review of literature. ASM Sci J. 2019;12:1–12.
11. Atan SA, Foskett A, Ali A. Special Populations : Issues and Considerations in Youth Soccer Match Analysis. 2014;4(3):103–14.
12. Sullivan AN, Lachman ME. Behavior Change with Fitness Technology in Sedentary Adults: A Review of the Evidence for Increasing Physical Activity. Front Public Heal [Internet]. 2016 Jan 11 [cited 2022 Sep 28];4(JAN). Available from: /pmc/articles/PMC5225122/

13. Sharples M. The design of personal mobile technologies for lifelong learning. Comput Educ. 2000 Apr 1;34(3–4):177–93.
14. Shah HASSAN I, Arif ISMAIL Fakulti Pendidikan M, Kebangsaan Malysia Ramlee MUSTAPHA U. The Effects of Integrating Mobile and CAD Technology in Teaching Design Process for Malaysian Polytechnic Architecture Student in Producing Creative Product. Turkish Online J Educ Technol - TOJET. 2010 Oct;9(4):162–72.
15. Hashim A. Pengujian Pengukuran dan Penilaian Pendidikan Jasmani [Internet]. Selangor: Dubook Press Sdn Bhd; 2015 [cited 2022 Sep 28]. Available from: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=5JvlJzgAAAAJ&citation_for_view=5JvlJzgAAAAJ:IWHjjKOFINEC
16. Safrit MJ, Wood TM. Introduction to Measurement in Physical Education and Exercise Science [Internet]. Mosby; 1995 [cited 2022 Sep 28]. 717 p. Available from: https://books.google.com/books?id=z29YAAAAYAAJ&pgis=1
17. Chinapaw MJM, Mokkink LB, Van Poppel MNM, Van Mechelen W, Terwee CB. Physical activity questionnaires for youth: A systematic review of measurement properties. Sport Med. 2010;40(7):539–63.
18. Ridgers ND, Timperio A, Crawford D, Salmon J. Validity of a brief self-report instrument for assessing compliance with physical activity guidelines amongst adolescents. J Sci Med Sport [Internet]. 2012 Mar [cited 2022 Sep 28];15(2):136–41. Available from: https://pubmed.ncbi.nlm.nih.gov/22051688/
19. Atkinson G, Nevill AM. Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. Sport Med. 1998;26(4):217–38.
20. Konting MM. Kaedah Penyelidikan Pendidikan [Internet]. Kuala Lumpur: Dewan Bahasa dan Pustaka; 2005 [cited 2022 Sep 28]. Available from: https://www.goodreads.com/en/book/show/23198702-kaedah-penyelidikan-pendidikan
21. Wheelan CJ. Naked statistics : stripping the dread from the data [Internet]. London: W. W. Norton & Company,; 2014 [cited 2022 Sep 28]. 282 p. Available from: https://wwnorton.com/books/Naked-Statistics
22. Hardy MA, Bryman A. Handbook of data analysis. Sage Publications; 2004. 704 p.
23. Portney LG, Watkins M. Foundations of clinical research Applications to practice [Internet]. Upper Saddle River: Prentice Hall Health; 2000 [cited 2022 Sep 28]. Available from: https://www.scirp.org/(S(i43dyn45teexjx455qlt3d2q))/reference/ReferencesPapers.aspx?ReferenceID=577760