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Research Article

Evaluation of the relationship pattern of (MOPC) and (APFT) tests in measuring aerobic power of military students

Hekmat ehsan baksh[1], Reza sabzevari rad [1]*

1. Department of Physical Education and Sport Sciences, Faculty of Basic Sciences, Imam Ali Officers' University, Tehran, Iran
2. Assistant Professor, Department of Physical Education and Sport Sciences, Faculty of Basic Sciences, Imam Ali Officers' University, Tehran, Iran

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Abstract

Background: military forces must be physically fit to perform the task in order to perform their specialized function properly and with minimal casualties in completely different and critical situations. So the purpose of this study was Evaluation of the relationship pattern of (MOPC) and (APFT) tests in measuring aerobic power of military students.

Materials and Methods: 25 Officer Students (21-25 years) were purposefully selected. At first, the MOPC (3mile run, MOB, Bench Press, Barfix, Back Squat, Simulated Casualty Evacuation Test) was performed. next stage was to perform the APFT functional test (540 m run, sit-ups, modified barfix, push-ups, sit -reach, 45 m run and agility with 4 x 9-meter test). The test was performed at the 10-day interval as MOPC. Thirdly, after one week of performing the main tests, respiratory gases (VO2, VCO2), RQ, lactate threshold (equivalent to 92% of VO2max), THR, intensity (VO2max%), O2pluse and aerobic power (VO2max) of subjects were assessed by Bruce's progressive and exhaustive test. the assumption of normality was verified using the Kolmogorov-Smirnov test. Also, linear regression analysis was used to examine the relationship between the two performance tests and Statistical analysis was performed at the significant level ($p < 0.05$).

Results: : Subjects' VO2max had a relatively weak correlation with MOPC (R = 0.26 and SEE = 0.05) and APFT (R=0.06 and SEE=0.18), which was not statistically significant. A moderate correlation(R=0.49) was observed between the two students' performance tests, however, this proportion was not significant with respect to the coefficient of determination (R2 = 0.28).

Conclusion: However, having adequate aerobic power for the military forces indicates optimal levels of cardiopulmonary fitness. But in terms of the level of specialized performance when performing the test, it is not able to evaluate proper motor readiness It is therefore suggested that the components of military performance tests be reviewed and refined.

by increasing Ceramide expression.

***Corresponding author:** Reza sabzevari rad
Address: , Imam Ali Officers' University,Imam Khomeini Street, Hor Square, Post Box 131789-3471, Tehran, Iran
Email: sabzevarireza63@email.com **Tell:** 00982167933381
R S R: 0000-0002-5397-1244

1. Introduction

Physical-motor fitness and Suitable body composition is a major concern of all armies and one of the determining factors in the efficiency and performance of military forces. The nature of military operation requires that the military person (whether in peacetime or during war) be physically fit(1) Activity and living in areas with limited facilities (in highlands, plains and forests) or undesirable geographical areas, having heavy physical activity, prolonged work, and the need to endure difficulties due to occupational nature are evidences of this claim(1). The physical fitness of a military is defined as the capacity to perform continuous and skillful movements, the ability to return to baseline after high pressure, the willingness to complete the intended tasks and the confidence to face any situation (2).Success or failure in missions and operations, in addition to advanced equipment and technology, depends on the physical and mental health and fitness level of the troops (1, 2). For example, the inadequacy of American troops on July 5, 1950, in the fight with Korean troops in the early days of the war led to American troops leaving the war zone and leaving their wounded companions and valuable equipment. Because their training to prepare inadequate physical-motor parameters could barely carry heavy cargo. The valuable lessons learned by the Smithsonian Task Force in Korea have led to a great deal of attention being paid to the physical fitness and fitness of the military at educational institutions throughout the United States (3) Research evidence suggests that high levels of physical fitness, especially cardio and respiratory endurance, and the ability to perform long-term exercises, have a significant effect on removing and modifying burnout and maintaining physical and mental health. On the other hand, the results of numerous studies indicate that military performance tests such as Casualty Evacuation Test, intermittent lifting, obstacle crossing, casualty transport and other military tests are improved with increased fitness (4-10). Vanderburgh et al. (2008) stated that in the United States, ground, naval, and air forces require regular physical fitness tests to enter the military and perform their duties. In most of their physical fitness tests, upper body strength and And endurance of the trunk muscles are evaluated (11). The difference in scores obtained in the various tests can also be attributed to the criteria for recruiting individuals, including optimal levels of fitness and anthropometric characteristics of military forces in different countries (12). Fakourian et al. Examined the impact of a selected military training course on aerobic performance with the 1600-meter run test, agility with 4 x 9-meter test, and muscular endurance with the sit-up and barfix tests. Based on the findings, it was found that the indicators of military physical performance are more responsive to selected military training (13). Improving the quality of physical training and military tests is also important to improve the military fitness. Recent Army Instructions and Doctrine Guidelines on Army Physical Fitness Exercises Based on Global Views, Army Units in Physical Planning Should Focus on Endurance, Strength, and Mobility as Key Factors (14). Unfortunately, some commanders still rely heavily on comprehensive APFT scores (both individuals and units) as a screening method when examining unit combat readiness (14) Herman et al. (2008) noted that when commanders are responsible for military units, they should focus on improving physical fitness based on the physical fitness scale. They also found that long-distance run, sit-up and push-ups tests were not a robust scale for determining military-related tasks. In recent decades, in order to improve the physical fitness of soldiers, tests and other factors such as speed, agility, coordination, strength and power have usually been considered (5) Among the tests and studies available to assess military readiness, the main focus is on assessing general fitness skills. And the

performance or combat readiness of the military in their real environment has been underestimated. In other words, in the past, more emphasis has been placed on 2-mile running, sit-down, push-ups tests to increase physical fitness. However, these tests were used for the 1970s and 1980s when the soldier had no physical fitness and also had many opportunities to reach the desired level of fitness (15). Studies conducted at the Army Health Research Center (Military Epidemiology Research Institute) have shown that some military exercises and training are not efficient in achieving physical fitness (16). Anthropometric and body composition studies are currently not included in Iranian physical fitness tests. In the other armies, however, these studies are only periodic examinations and tests (17). In addition, technological advances have also led to increased body strength and potential overload of military personnel. As the weight of personnel equipment increases, metabolic and physiological demand increases (1). The Military Optimal Performance Challenge (MOPC) is a novel test that examines the capability of individuals in the military with physical fitness factors and deals with the examination, recording, and comparison of individuals in a specialized manner (1). Given the completeness and accuracy of the MOPC test package over other similar specimens, in recent years various countries have used this MOPC test kit as a standard norm to enhance the capability of their troops. In addition to physical factors, this test evaluates the cases in which a fighter may be exposed to the combat environment (1). Given the importance of physical fitness and body composition in the armed forces, all military units and personnel in all ranks should use optimal military performance tests to enhance these two factors. In order to record the results and evaluate the performance of individuals, comparing the individual with his or her own past and comparing them with other people, the need for classified tests is felt. The purpose of this study was to evaluate the accuracy and capability of MOPC and APFT according to cardiovascular fitness level in military students.

2. Materials and Methods

Subjects

This study was a descriptive-analytical study which was carried out in autumn 2018. Participants in this study were Officer Students (21-25 years old) of Imam Ali University of Tehran. 25 volunteers were purposefully selected using Morgan et al.'s sample size estimation table. All subjects completed PAR-Q (Physical Activity Readiness Questionnaire). Inclusion criteria included general health and initial physical fitness and non-use of medication by subjects. In addition, a rest electrocardiogram was performed at the National Olympic Laboratory.

Exercise protocol

Prior to the exercise protocol, participants performed warm up exercises, upper and lower leg stretching exercises. The MOPC test was held in the 60*40 m multifunctional hall along with a standard track and field track at Imam Ali's Officer University. In order to standardize and increase the reliability of the test results with emphasis on the Arranging the test run, the test was conducted in two sessions. At each station, elementary education was given precise and sufficient training to increase participants' assistance with Test recipients. Exclusion criteria included non-co-operation and incomplete data of participants for any reason, as well as possible injury or history of musculoskeletal injury in recent months. None of the participants met the exclusion criteria.

The MOPC test components consisting of 7 tests were implemented as follows:

Test 1. 3mile run (4827m Run): This test was performed at a designated distance around the track and the cardiopulmonary endurance capacity was measured. Test 2. Mobility for Battle: This test measures high-intensity motor performance. This test consists of a series of high-intensity motor barriers and tasks that a soldier must successfully complete within a specified time (Figure 1). Test 3. Number of Repetitions with Fixed Weight of Bench Press. This test evaluated the high intensity physical work capacity (high trunk strength). and shoulder gridle.

Test 4. Barfix/Horizontal bar for Middle Shoulder. This test measures the muscular endurance of the hands Test 5. Ankles to the Bar. This test evaluated the lower trunk strength.Test 6. Back Squat. This test evaluated the lower trunk strength.Test 7. Simulated Casualty Evacuation Test. This test evaluates high- intensity desirable performance.

Each error in the execution of each item was added to the time of execution of each individual task. The test was conducted under the supervision of a sports officer with all safety-training tips. The next stage was to perform the APFT functional test (540 m run, sit-ups, modified barfix, push-ups, sit -reach, 45 m run and 4 x 9-meter test). The test was performed by two referees at the 10-day interval as the first functional test. The first referee, recording errors at each station, and the second referee, had the task of announcing the start and recording time. The results of each subject were recorded in the performance test based on the errors of each subject (18).

In the third stage, after one week of the main tests, the students were randomly divided into 5 groups include 5 subjects. Subjects' cardiovascular variables included respiratory gas (VO2, VCO2), respiratory rate (RQ), lactate threshold (equivalent to 92% of maximal oxygen consumption), exercise heart rate, work intensity (VO2max%), oxygen pulse (O2pluse) and Aerobic power (VO2max) was evaluated by standard methods by a sports physiologist at the National Olympic Laboratory. Aerobic capacity measurement by analyzing respiratory gases (VO2, VCO2), Target Heart rate (THR), and RQ at the last 15 seconds of each 3-minute step (activity on treadmill under ambient load conditions) by observing both RQ> 1.1 and HRmax THR> 0.90 Measured by an automated machine (Quark-B2, Italy) (20-23). The information of the subjects working on the treadmill (Bruce's progressive and exhaustive program) was measured in STPD (Standard Pressure and Temperature, Dry) in the Computer Memory of the Device (COSMED; US Made) Record.

In the Bruce protocol, the first person walked (at 22.3 ° C) for 5 minutes at Heart Rate= 95- 118 beats per minute. Then the speed of the machine started at 3 km / h and every minute was added to the previous speed of 1 km/h. subjects near the lactate threshold level were verbally encouraged to reach maximal voluntary fatigue (19, 20).

Statistical analysis

All data are reported as means and standard deviations. Before using parametric tests, the assumption of normality was verified using the Kolmogorov-Smirnov test. Also, linear regression analysis was used to examine the relationship between the two performance tests. The difficulty level of test performance in proportion to the time spent on each of the two test components, which was dependent on the parameters of speed, accuracy, agility, muscle endurance, and subject coordination, was measured by histograms and Q-Q diagrams. The relationship between the cardiac performance index of subjects, aerobic power (VO2max) with both tests was investigated by linear regression method. Statistical analysis was performed at the significant level ($p < 0.05$).

3. Results

The anthropometric indices and the results of the functional test of the subjects are presented in Table 1. Their record in the MOPC and APFT tests was 161.7 and 263.2, respectively. Direct aerobic capacity values were 39 to 53 ml/kg for two minutes and Target heart rate (THR) was 161 to 199 bpm equal to 49 to 80% of the subjects' aerobic power (Table 2). A moderate correlation was observed between the two students' performance tests (Table 3), however,this proportion was not significant with respect to the coefficient of determination (R2 = 0.28).

Table 1. The anthropometric indices and the results of the functional test of the subject

Variable / Statistics	Performance Test (Score)		BMI (kg/cm^2)	Height(cm)	Weight(kg)
	APFT	MOPC			
Mean	263.2	161.7	18	171.9	66.075
SD	29.6	37.9	16.4	5.18	9.23
Minimum value	230.6	148.3	15.7	167.53	59.48
maximum value	291.7	202.1	20.3	176.27	72.66

Table2. Physiological variables During the exhausting test

Variable / Statistics	Intensity (%VO_2max)	Heart Rate (bpm)	VO_2max (ml/kg/min)	Pulse O_2
Mean	64.12	180.61	46.05	18.1
SD	9.63	8.98	3.21	2.15
Minimum value	49	161	39.01	13.2
maximum value	79	199	53	23

Table 3: Relationship of mean APFT performance tests with MOPC

Statistics / Performance test	Mean	SEE	R	R2	P value
APFT	263.2	0.128	0.49	0.28	0.005
MOPC	161.7				

Abbreviations: SD; The standard deviation, APFT; Army physical fitness test, MOPC; Military Optimal Performance Challenge, BMI; body mass index.

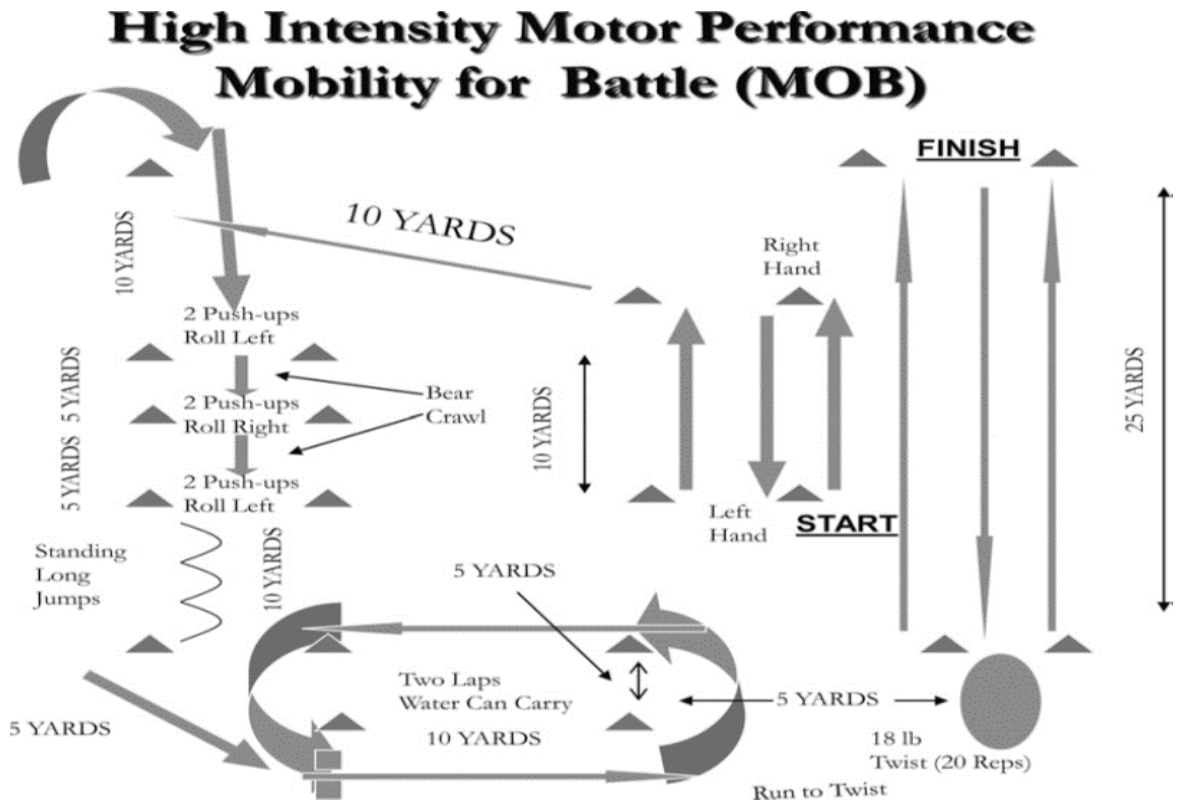

Figure 1. Mobility for Battle**.** This test measures high-intensity motor performance. This test consists of a series of high-intensity obstacles and tasks that a soldier must successfully complete within the specified time.

4. Discussion

Researchers report improvement in fitness level by assessing military fitness during 1975- 2003. It has also been stated that high-level physical fitness enables the military to carry out targeted missions with minimal fatigue and energy (21). Regular exercise also improves individual ability and general health (22). In the military forces, high levels of physical fitness are essential not only for health but also for special military functions and injury prevention. Experimental and field research has shown that soldiers with higher physical fitness have better performance in actual or simulated military operations, and those with lower fitness are more susceptible to injury (23-28)In more than 20 case studies, factors such as muscular strength and endurance and cardiovascular fitness have been reported as key elements in military service during combat. In recent years, researchers have been designing and implementing various tests that have yielded different results at different times, and these results have contributed greatly to the growing military trend of different countries. But gathering data, evaluating and quantifying the position of the military in real battle scenes and maneuvers is a difficult task. The weaknesses of the organizations involved in standardizing the functions and formulation of the norms of fitness of the armed forces of the country are barriers that do not provide a detailed description of the physical needs of the military and the factors contributing to its problems (21). In planning military exercises, trainers need information such as determining the level of fitness required of different combat units and units according to the type of duty and responsibility and performing physical fitness tests to determine individuals' physical fitness. The necessity of physical activity and physical tests in the military has been emphasized by Knapik (1989). Heydari et al. (2009), based on the findings of their research, concluded that the physical fitness of soldiers increases during training, but this amount does not provide all the dimensions of physical fitness required for successful military operations (29). Muscle strength plays a key role in carrying heavy ammunition and performing military duties and cardiovascular fitness (25, 28)In a study comparing the effect of selected combined exercise and current exercise training on improving physical fitness levels, Nikroo et al(2014) Suggested that selected combination exercise training program more effective response to improved physical fitness levels in soldiers than current exercise training(27). Colmenero et al. (2014), investigate a relatively large number of experiments evaluating muscular endurance (eg sit-ups), maximal strength (eg grip strength, vertical jump, etc.) and flexibility (eg sit and reach) in military. They stated that the major problem when assessing skeletal muscle fitness is that there is no appropriate standard for the test. For example, different types of sit-ups (a number of tests in one minute, a number of tests in two minutes, and a number of tests to fatigue, etc.) have been prevented from comparing studies(24). It should be noted that many of the tests in this study have focused on assessing skeletal muscle fitness in the upper body. The upper-level power seems to have a greater impact on military duties. However, low trunk evaluation is also of great importance with regard to the combat duties of military or security forces (23). Considering the high endurance and muscle strength needed to carry the injured, lifting the ammunition box, carrying military equipment on the sidewalks, as well as moving equipment, officers and ground forces And this is an important factor in military activity. Marić et al (2013) stated that physical activity programs over a four-year

period only slightly improve students' physical abilities (26). Bararpour et al (2016) found that the highest scores in cardiovascular tests and the lowest scores in endurance and muscle strength tests, respectively, were found in In assessing the physical and motor fitness of the officers, students(23). Spartali et al. (2014) examined anthropometric indices as predictors of physical performance in Greek military students. Their results showed that students with lower BMI and body fat achieved better results during performance tests. Body fat percentage was a more accurate predictor of performance than BMI. In general, the use of more than one component of anthropometric characteristics was emphasized to classify students' physical status, and the case is not purely based on BMI values (30). Jones et al. (2012) also examined the results of individual tests of the US Army Physical Fitness Test (PFT) and BMI of military students. They stated that if there was a correlation between BMI scores and the military fitness test, more accurate commanders could organize future fitness assessments (31). Their results showed no significant relationship between BMI and push-ups, sit-ups, or 2-miles run. .BMI does not accurately predict students' military fitness test scores. They said further studies are needed to determine the relationship between military fitness test scores and other anthropometric measures. In addition, in the research on non-military, the results of Monyeki et al. (2007) showed that there is a significant relationship between physical composition and physical fitness. Of course, this is not always the case in the expected direction and it is important to note that BMI should not be considered as a measure of obesity or overweight and can be an indicator of muscle mass (32). According to the research conducted on the military in different countries over the years and the results obtained for the best possible performance along with the militarization system, the countries are using different systems to enhance the capability of their forces. In most countries, physical fitness factors (speed, agility, coordination, strength, power and endurance) have been used (33). According to the present studies in Iran, unfortunately, there is no proper field test model to measure the military performance. Among the tests and studies available in assessing military readiness, tests have focused more on assessing general fitness skills and less on military performance or combat readiness in their actual environment. The purpose of this study was to evaluate the accuracy and capability of MOPC and APFT according to cardiovascular fitness level.

The results of this study showed that 25 military students with BMI equall 15.7-20.3 kg/m2 and with average body composition of 18 kg/m2 showed moderate correlation with APFT functional test (R = 0.49 and SEE = 0.12). Note that the distribution of test record time in MOPC tends to be negatively skewed. This is considered an indicator for assessing speed and coordination during battle and maneuvers, so that fewer people were able to achieve acceptable standard scores than the APFT test. As a result, subjects reported performing the MOPC test a bit more difficult than the APFT test. Given that (R2 = 0.28), that is, the dependency between the two functional tests of alliance is influenced by other confounding factors that are outside of the existing components and that the role-play tests. In other words, even the 50% runtime or record of military fitness scores in the APFT test cannot be predicted from the MOPC test score. Therefore, in spite of the subjects having the best body composition and optimal cardiovascular endurance,

they need more motor abilities. Therefore, the MOPC test can be recommended for better evaluation of military training. However, comparing these two tests in actual combat or combat situations and studying the biophysiological variables during execution requires further research. The results are agreement with the results of the Crowder et al (2013) in which they found that two push-ups and sit-ups tests had the highest scores (Score 4) in terms of significant correlations with other assessments. push-ups with sit-ups, ATB, CPU, MOB and ATB were significant and sit-ups with push-ups, 2B, MOB, ATB was significant. In addition, the global structure of endurance is unique and different from power (12). There is no single measurement unit that assesses both power and endurance, and this certainly applies to and sit-ups and push-ups. If one wants to consider a particular global structure for Army readiness, one must evaluate the variables of endurance, strength, and mobility. Multifaceted aspects are crucial to the readiness of the military, the highest individual MPOC performance (92.8%, 232) is related with APFT scores (294, 98%). Also the lowest individual performance with high scores of MOPC (79; 31.6%) and Mean APFT scores (236; 8.7%) were correlated. The results show that soldiers are only able to perform the 135-pound bench press for 7 reps and are able to perform in the MOB for 110 seconds, which is 31 seconds lower than the fastest soldier record (12). In the present study, based on the internal correlation test between MOPC test items, it was shown that the reliability of the military specialty test is high and acceptable. In other words, in order to evaluate combat capability and military performance in war, using a military performance test is an appropriate choice. The MOB test measures high-intensity power, but the SCET test evaluates the overall fitness factors of high-intensity soldiers. Therefore, MOB testing incorporates the essential factors of physical fitness that are power-based military exercises. Bompa believed that based on an exercise model, more strengh, endurance, speed and power were needed to maintain the best performance (33). All of these factors have been applied to the MOB test and it can be stated that the specificity of the MOB test for the military skills in the present study can be justified. In this study, among the controllable limitations to age and sex of subjects, time and place of training, subject's living conditions and uncontrollable limitations to individual differences, Subjects' levels of motivation, variations in interest, and physical and physiological characteristics of the subjects were noted.

Conclusion

However, having adequate aerobic power for the military forces indicates optimal levels of cardiopulmonary fitness. But in terms of the level of specialized performance when performing the test, it is not able to evaluate proper motor readiness It is therefore suggested that the components of military performance tests be reviewed and refined.

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Compliance with ethical standards

None declared.

Ethical approval the research was conducted with regard to the ethical principles.
Informed consent Informed consent was obtained from all participants.

Author contributions

Conceptualization: MS., KH.J.D F.T.; Methodology: MS.., KH.J.D, F.T.,.; Software: MS.,., KH.J.D., FT Validation: MS., KH.J.D., F.T.; Formal analysis: KH.J.D., F.T.; Investigation:., KH.J.D., F.T.; Resources: MS., KH.J.D ,F.T. Data curation: MS., F.T., KH.J.D.,.; Writing - original draft: MS., F.T., KH.J.D.; Writing - review & editing: MS., KH.J.D ,F.T.,.; Visualization: MS., F.T., KH.J.D.; Supervision: MS.,., KH.J.D., F.T.; Project administration: MS., KH.J.D., FT.; Funding acquisition: MS.,., KH.J.D., F.T

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