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Correlations between the simulated military tasks performance and physical fitness tests at high altitude

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ORIGINAL ARTICLE

ABSTRACT

The aim of this study was to investigate the Correlations between the Simulated Military Tasks Performance and Physical Fitness Tests at high altitude. This research is part of a project to modernize the physical fitness test of the Colombian Army. Data collection was performed at the 13th Battalion of Instruction and Training, located 30km south of Bogota D.C., with a temperature range from 1ºC to 23ºC during the study period, and at 3100m above sea level. The sample was composed by 60 volunteers from three different platoons. The volunteers start the data collection protocol after 2 weeks of acclimation at this altitude. The main results were the identification of a high positive correlation between the 3 Assault wall in succession and the Simulated Military Tasks performance ($r = 0.764$, $p<0.001$), and a moderate negative correlation between pull-ups and the Simulated Military Tasks performance ($r = -0.535$, $p<0.001$). It can be recommended the use of the 20-consecutive overtaking of the 3 Assault wall in succession as a good way to estimate the performance in operational tasks which involve: assault walls, network of wires, military Climbing Nets, Tarzan jump among others, at high altitude.

Keywords: Simulated Military Tasks, Obstacle course, Physical Fitness Tests, Moderate Altitude.

INTRODUCTION

The readiness and physical resilience of each soldier are essential for the good operational performance of a troop. Thus, an adequate and periodic assessment is a prerequisite for maintenance and improvement of a military readiness (Rohde, Sievert, Rüther, Witzki, & Leyk, 2015). Nowadays most military physical fitness tests (MPFT) still not adequate to reproduce and monitor physical requirements of military tasks (Jonas, O'Connor, Deuster, & Macedonia, 2010).

On the other hand, some nations start to developed additional mission-related test methods to assess operational readiness, such as: the Combat Fitness Test of the U.S. Marine Corps (United States of America, 2015) and FORCE Fitness Profile of the Canadian Armed Forces (Gagnon, Spivock, Reilly, Mattie, & Stockbrugger, 2015). This can be considered a change in MPFT philosophy, but these tests have to be feasible to assess a large number of military in a few time (Wyss, Marti, Rossi, Kohler, & Mader, 2007).

However, some missions must be done in adverse conditions, as in high altitude (Derby & Weber, 2010; United States of America, 2002), and in this case, the hypoxia can alter the performance of troops in some activities, because it decrease the maximal consume of oxygen in 17% (Consolazio, Nelson, Matoush, & Hansen, 1966). Moreover, military tasks in cold weather at moderate altitude are accompanied by increases in several indicators of oxidative stress such as: breath pentane, oxygen radical absorption capacity, and lipid peroxides (LPO) (Chao, Askew, Roberts, Wood, & Perkins, 1999). Thus, it makes sense to know the response of troop to this kind of stimulus, nevertheless how to do it in places without large military areas or buildings which allow simulating military tasks? One solution can be the use of physical fitness tests which are strongly related with military tasks performance (Gagnon, 2016). In this sense, the aim of this

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study was to investigate the Correlations between the Simulated Military Tasks Performance and Physical Fitness Tests at high altitude.

METHOD

This research is part of a project to modernize the physical fitness test of the Colombian Army. Data collection was performed at the 13th Battalion of Instruction and Training, located 30km south of Bogota D.C., with a temperature range from 1ºC to 23ºC during the study period, and at 3100m above sea level.

The sample was composed by 60 volunteers from three different platoons. The volunteers start the data collection protocol after 2 weeks of acclimation at this altitude. During these 2 weeks they have had different kind of operational and physical instructions. All volunteers signed written informed consent, and all procedures were carried out in accordance with the Declaration of Helsinki and national guidelines.

First, it was established the Simulated Military Tasks to serve as a gold standard, by the Colombian Army Direction of Training and Instruction. After, it was done a selection of the physical fitness test which could be done in small military areas, safe and easy applicable; and requires little material, time, and few personnel. The others phases of this study are presented in the Figure 1.

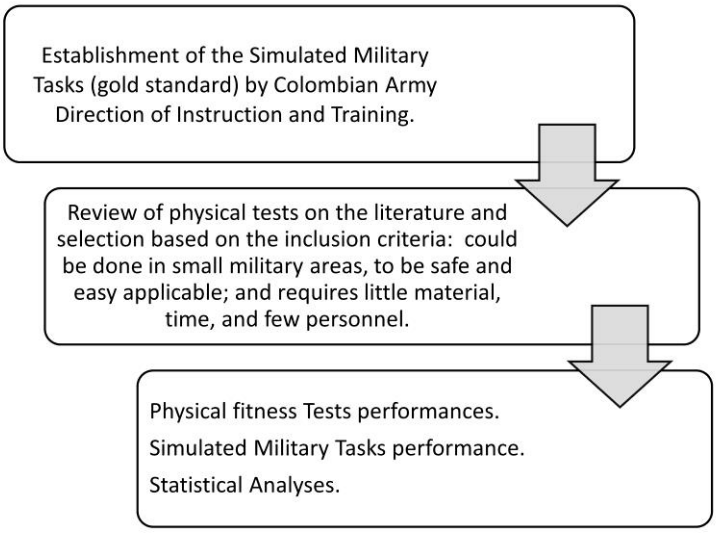


Figure 1. Study design

Three days before start data collection, volunteers were instructed to avoid strenuous physical activities for at least 24 hours prior to the evaluation (Rosa et al., 2017). Data collection start on Monday (Day 1) and was carried out according to the sequence presented in Figure 2.

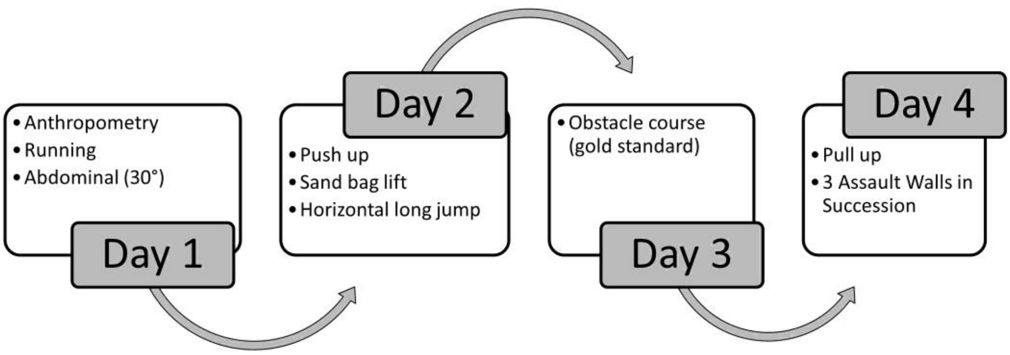
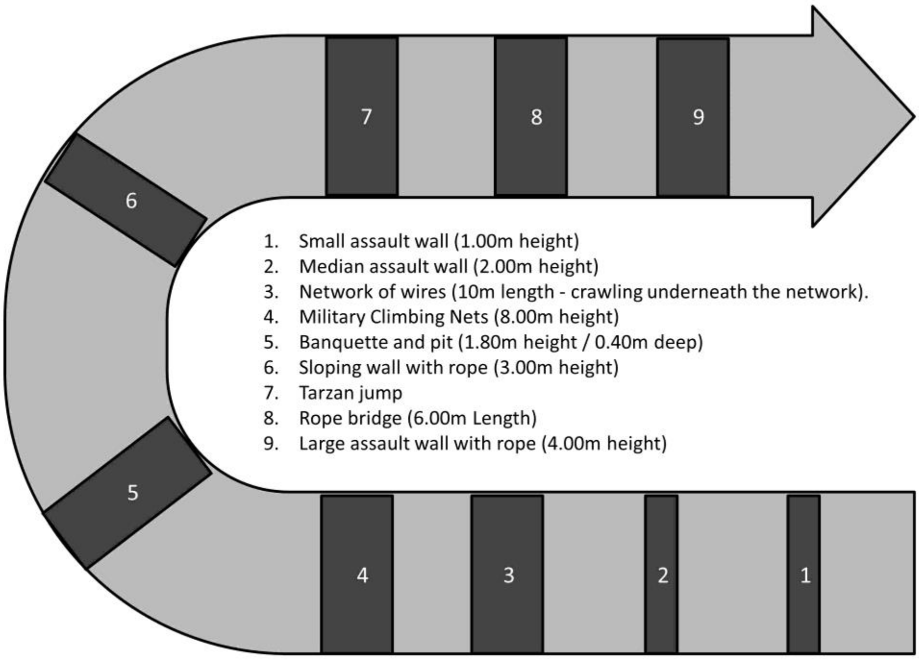


Figure 2: Data collection protocol

During anthropometric measurements, body mass was measured in kilograms (kg) using a Filizola scale with an accuracy of 100 g and a range of 150 kg. Height was measured in centimetres (cm), using the Frankfurt plane as a reference. From these measurements, it was obtained Body Mass Index (BMI) values (weight/height^2) (Neves, 2008). Abdomen circumference was measured on the umbilicus using a flexible steel tape and recorded in millimetres. The fat percentage (Fat%) was calculated by the following equation proposed by Salem (2008).

$$Fat\% = 0.061 \times Age + 16.002 \times (AC)^{0.5} - 5.056 \times (BM)^{0.5} - 91.222$$

Where: AC = Abdominal circumference, and BM = Body mass.



Total length = 270m

Figure 3: Simulated Military Tasks (Obstacle course from Colombian Army) used as gold standard in this study

Table 1.
Physical fitness tests selected to be performed by the volunteers of this study

Test	Used by	Observations
Running	American College of Sports Medicine (ACSM, 2013)	Distance of 3000m
Abdominal	American College of Sports Medicine (ACSM, 2013)	Abdominal 30°
Push-ups	American College of Sports Medicine (ACSM, 2013)	-
Horizontal Long Jump	Norway Army (Gagnon, 2016)	The best of 3 attempt
Sandbag Lift	Canadian Army (Gagnon et al., 2015)	Time of 30 consecutive lifts of a 20 kg sandbag from the floor above a height of 1.0 m.
Pull-ups	Brazilian Army (Exército Brasileiro, 2015)	-
3 Assault wall in succession	This is the last obstacle from the Obstacle run of Military Pentathlon (Exército Brasileiro, 2015)	Time of 20 consecutive overtaking

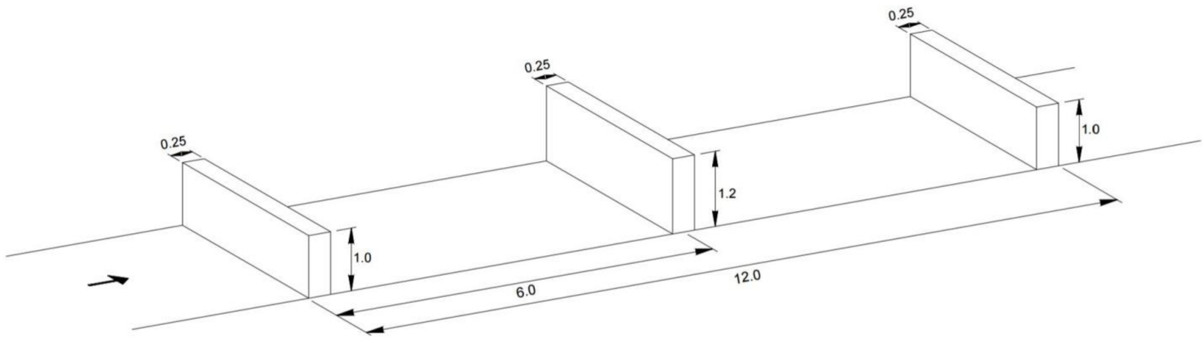


Figure 4: 3 Assault Walls in Succession (measures in meters)

The Simulated Military Tasks were selected from an obstacle course which already existed in the 13th Battalion of Instruction and Training. Nine from twelve obstacles were selected to be performed as presented in the Figure 3.

The physical fitness tests selected were presented in the Table 1. The last test, 3 Assault wall in succession was illustrated in Figure 4.

The data analysis started with the normality verification using the Shapiro-Wilk test. Once some variables show a nonparametric distribution, descriptive data are presented as minimum, maximum, mean, median, standard deviation, interquartile range. The correlation analysis was performed with Pearson correlation coefficient and Spearman Rank Correlation, according to the type of distribution presented by each variable (Mukaka, 2012). The analyses were performed using the software Statistical Package for Social Sciences version 21.0. The significance level was set in 0.05.

RESULTS

The Table 2 presents descriptive data from 60 Colombian militaries from three different platoons which did the simulated military tasks and physical fitness tests selected for this study. The Table 3 presents the correlation coefficients between the simulated military tasks performance (Obstacle course illustrated in the Figure 3) and the physical fitness tests selected.

Table 2.

Descriptive data of 60 Colombian militaries from three different platoons which did the Simulated Military Tasks (Obstacle course) and Physical Fitness Tests, Colombia, 2017.

	Shapiro-Wilk	Mínimo	Máximo	Average	Standard Deviation	Median	Interquartile range
Age (years)	0.015	23.00	41.00	32.13	5.01	32.00	9,00
Body mass (Kg)	0.097	56.00	84.00	70.09	7.53	70.00	11.00
Height (cm)	0.706	154.00	185.00	169.33	6.78	170.00	9.50
Body Mass Index	0.205	20.00	29.00	24.42	2.14	24.00	2.75
Abdominal Circunference (cm)	0.505	69.00	101.00	85.93	7.03	85.50	11.50
Fat Percentage	0.438	3.94	28.02	16.95	5.19	16.07	7.04
Running (s)	0.181	11.32	17.32	889.20	86.40	867.00	116.00
Abdominal 30° (rep)	0.382	13.00	70.00	38.02	13.07	37.50	18.00
Push-ups (rep)	0.235	9.00	60.00	32.00	9.79	31.00	12.50
Horizontal Long Jump (cm)	0.810	162.00	272.00	205.98	22.31	207.00	28.25
Sandbag Lift (s)	0.126	51.00	86.00	64.32	8.24	64.00	9.75
Simulated Military Tasks Performance (s)	0.194	170.00	420.00	271.92	59.64	259.50	88.25
Pull-ups (rep)	0.004	1.00	20.00	6.49	4.33	5.00	7.00
3 Assault wall in succession (s)	0.320	159.00	298.00	217.94	32.45	216.50	41.75

Table 3.
Correlation coefficients between the Simulated Military Tasks (Obstacle course) and the Physical Fitness Tests (N=60), Colombia, 2017.

Correlations	Simulated Military Tasks Performance (s)	p value
Running (s)	r = 0.273*	0.036
Abdominal 30° (rep)	r = -0.189	0.151
Push-ups (rep)	r = -0.416*	0.001
Horizontal Long Jump (cm)	r = -0.391*	0.002
Sandbag Lift (s)	r = 0.146	0.277
Pull-ups (rep)	ρ = -0.535*	<0.001
3 Assault wall in succession (s)	r = 0.764*	<0.001

ρ = Spearman Rank Correlation, r = Pearson correlation coefficient, * Significant correlations.

Regarding to the anthropometric variables, the Pearson correlations coefficients with the simulated military tasks performance were: 0.279 with body mass ($p=0.039$), 0.079 with height ($p=0.565$), 0.271 Body Mass Index ($p=0.046$), 0.527 with abdominal circumference ($p<0.001$), and 0.505 with fat percentage ($p<0.001$).

DISCUSSION

The objective of this study was to investigate the correlations between the Simulated Military Tasks Performance and Commons Physical Fitness Tests at high altitude. The main results were the identification of a high positive correlation (Mukaka, 2012) between the 3 Assault wall in succession and the Simulated Military Tasks performance ($r = 0.764$, $p<0.001$), and a moderate negative correlation between pull-ups and the Simulated Military Tasks performance ($r = -0.535$, $p<0.001$).

These results agree with those found by Pihlainen, Santtila, Häkkinen, and Kyröläinen (2017) when studied soldiers from Finnish Defense Forces, and they reported a moderated correlation between the countermovement jump performed with the combat load and a military simulated test (MST) time ($\rho = -0.659$, $p<0.001$). They also find significant correlations among the MST time with Pull-ups ($\rho = -0.435$, $p<0.001$), and fat percentage ($\rho = 0.534$, $p<0.001$). In the present study, it was found a similar correlation coefficient among the simulated military tasks with Pull-ups ($\rho = -0.535$, $p<0.001$), and the fat percentage ($r = 0.505$, $p<0.001$).

The high positive correlation coefficient found between the 20 consecutive overtaking of the 3 Assault wall in succession and the simulated military tasks reinforce the idea reported by Pihlainen et al. (2017) that the endurance capacity and the muscle power of the lower extremities are crucial performance components in anaerobic combat situations, even at high altitude (3100m above sea level).

However, the correlation coefficients depend of the operational tasks stablished as reference, i.e. those defined by Canadian Armed Forces (escape to cover, picking, digging, stretcher-carry and sandbag fortifications, among others…), in a project named FORCE program (Gagnon, 2016), in which they did similar analyses between operational tasks and physical fitness tests. The correlation coefficient between the stretcher-carry task and sandbag lift was 0.737, and between push-ups and the sandbag fortifications task was 0.599. In the present study, these physical fitness tests (sandbag lift and push-ups) did not show good correlations coefficients with the simulated military tasks composed by assault walls, network of wires, military Climbing Nets, Tarzan jump among others illustrated in Figure 3.

Most of the studies were done in low altitude. This study brings some results of correlations between simulated military tasks performance and physical fitness tests at 3100m above sea level. The sample size and the guarantee of the same level of subject’s motivation in all days of this study protocol can be cited as a limitation of this study. Future procedures involve increase the sample size and the test of reliability of the physical fitness tests performed.

PRACTICAL APPLICATIONS

For while, it can be recommended the use of the 20-consecutive overtaking of the 3 Assault wall in succession as a good way to estimate the performance in operational tasks which involve: assault walls, network of wires, military Climbing Nets, Tarzan jump among others illustrated in Figure 3, at high altitude (3100m above sea level). This test can be done in small military areas, it is safe and easy applicable; and requires little material, time, and few personnel.

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Nothing to declare

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