Physical Fitness in Spanish Naval Cadets. A 4-year Study

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Research

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Abstract

Background: Military physical readiness largely depends on Soldiers maintaining the level of general health and physical fitness to perform their requisite occupational duties in garrison and deployment environments. To know the physical fitness of naval cadets throughout its formative stage, will help us define a training program tailored to your needs. The objective of this study was to analyse the physical fitness of the cadets enrolled in the Military training in the academic year 2018-2019 in the XXXX.

Methods. A longitudinal correlational-descriptive design was developed. 167 of the 292 students who participated in the global analysis participated in the pre and post (first and second semester) physical fitness tests (153 males and 14 females, mean age 21.86±3.5) and were stratified by age groups. Anthropometric and data from the Spanish army physical fitness assessment system (2 min Push-Ups, 1000 and 50m races, Vertical Jump and 50m swimming) was used. A descriptive, inferential and correlational analysis was carried out and the level of significance set for the study was $p \leq 0.05$.

Results. Inferential analysis between marks by age group and for the total sample shows statistical differences for the total sample in the 1000m and 50m race ($p<0.001$) and in Vertical Jump test ($p<0.01$). There was significant statistical correlation between all the five tests developed.

Conclusion. The level of physical fitness of cadets at the XXXX appears to be acceptable when compared to other countries military naval corps. A coherence between training and evaluation is of extremely importance and probably a rethinking on resistance and power strength should be necessary.

Background

Military physical readiness largely depends on Soldiers maintaining the level of general health and physical fitness to perform their requisite occupational duties in garrison and deployment environments [1–3]. A physically capable force is required to perform essential military task. The importance of physical fitness applies to the general population, but for military personnel, achieving a high level of physical fitness may be necessary to be successful at their job [4–6]. Additionally, combat deployments may last for extended periods and soldiers are expected to maintain their fitness level during this time. Maintaining fitness during deployment may be achieved by the physical requirements and demands of the soldier's occupation, through the implementation of structured physical training 5. Military units typically train as a group when conducting physical training. Training is used as much for physical conditioning for the demands of the job as it is for stimulating esprit de corps, teamwork, camaraderie, and mental resilience [7].

The training of new recruits, including the physical capacities necessary to be an effective operational soldier places important consideration on military training systems and curricula. Additionally, these training systems and curricula must also be sufficiently robust to ensure satisfactory recruit or cadets' progression within a period [8, 9]. Each service branch determines the necessary physical fitness testing needed to maintain minimal levels of fitness and strength for its members' respective duties [6, 10–12]. Physical fitness assessments are an essential component in measuring the physical capacities of all Service Members [1]. For example, in the United States of America (USA), soldiers must meet fitness standards to remain in the military. The Army Physical Fitness Test (APFT) is the tool used to assess physical fitness and is taken twice a year in an active duty population consisting of three events: extended-leg Push-Ups, bent-knee Sit-Ups and a timed 2-mile run [13].

Enough levels of physical fitness are emphasized in military personnel due to the high physical demands during military training and in warfare [10, 11]. In the USA, soldiers who fail the APFT usually participate in a remedial physical training program and repeated failures can lead to discharge from military service [13].

Physical-sport practice assignments should be oriented to the personal conditioning. Although leaders acknowledge that physical fitness tests are part of military service, those tests' marks are not a proven predictor of military physical fitness success and the specificity of performance-related fitness requirements should vary depending on the individual's mission [10]. It would be important to highlight that in Spain, between the different Military Corps, tests used to assess military personnel physical fitness are different and no battery is scientific validated nowadays. Furthermore, In Spain, each of the armed services conducts some variation of an annual or semester physical tests. The periodic physical tests developed are in accordance with the Spanish Ministerial Order 54/2014, November 11th .

Based on the above commented, the objective of this study was to analyse the influence of age and physical activity programme on the fitness of Spanish cadets enrolled in the five years duration of the Bachelor's degree and Military Training in the academic year 2018–2019.

Methods

This study has a quantitative approach and uses a longitudinal correlational-descriptive design, and it is part of a longitudinal study in collaboration with XXXX from 2018 to 2022 under the XXXXX endowed chair.

The sample included the students enrolled in the five years duration of Bachelor's degree and Military training at the XXXX attached to the XXX during the academic course 2018/2019. 167 of the 292 students who participated in the global analysis participated in the pre and post physical fitness tests and consequently have been included in the study sample (153 males and 14 women, mean age 21.86 ± 3.50).

This study is in accordance with the Helsinki Declaration with respect to data collection and processing (World Medical Association, 2013) and with the Spanish *Ley Orgánica de Protección de Datos de Carácter Personal* and the project has been approved by the local XXX Ethical Committee with the code number 03-719.

The anthropometric assessment was carried out by specialized technicians and developed in the multi-use room the week before the physical tests. The Anthropometric assessment followed the International Working Group of Kinanthropometry (ISAK) protocol [14]. The instrument included students' weight, height, and Body Mass Index (BMI). Height was measured using a telescopic measuring rod SECA (SECA, Germany) with a measuring accuracy of 0.1cm. Weight was measured using a bioimpedance device Tanita (TBF300) with a measuring accuracy of 100g. To the body composition study, the fat percentage was calculated based on the BMI, using the following formula: weight/height^2 (kg/m^2).

The Spanish army physical fitness assessment system provides information to the physical activity training and to the recruit's preparation. This assessment allows defining an individual physical profile including the three correspondent aspects of physical qualities groups: strength, endurance and speed. This instrument includes the General Physical Condition Test and the Specific Physical Condition Test. Physical Fitness Assessment (Supplementary material) was carried out using different test included in the General Physical Condition Test [15].

Assessment were carried out in three different installations: in an athletics track (50m race and 1000m race), in a multi-use room (Vertical Jump and 2 minutes Push Ups) and in an indoor swimming pool (50m swimming). The first assessment was carried out for a week, in the mornings from 8:00 to 9:30 in January. The second assessment was carried out also for a week, in the mornings, from 12:30 to 14:0 in May. The first day the 1000m race was done, the second day the 50m swimming, the third day 2 minutes Push Ups and Vertical Jump, the fourth day 50m race and the fifth day test with those participants who could not do the previous days. Anthropometric assessment was developed in the multi-use room the week before the physical tests. Before the physical fitness tests participants warmed 15 minutes accordingly to the tests to be done. The physical fitness tests were carried out by military personnel of the Physical Activity Department, professionals used to take measures of such physical fitness tests. Anthropometric assessment was carried out by specialized technicians.

A descriptive statistical analysis based on data has been carried out using central tendency measures and deviations, being this analysis stratified by age. In order to verify the data for normality, the Shapiro-Wilks test was used ($p > 0.05$). To determine if the training programme has significant influences on anthropometric and physical fitness variables, a Student T test for paired data was used. With a view to identifying the association among the used Physical Fitness tests for both first and second semesters, a correlational analysis was carried out. Statistical analysis was performed using IBM-SPSS v25 for Mac. The level of significance was $p < 0.05$.

Results

Table 1 shows descriptive analysis and sample characteristics by age groups. Total sample was composed by 167 students between 18 and 37 years old.

Table 1
Descriptive analysis by age groups.

	All		**18–19**		**20–21**		**22–23**		**24 - …**	
	n = 167		**n = 69**		**n = 44**		**n = 27**		**n = 27**	
	mean/%	sd	mean/%	sd	mean/%	sd	mean/%	sd	mean/%	sd
Gender (% male)	91,69%		91,78%		86,76%		97,22%		87,93%	
Age (years)	21,86	0,85	18,63	,49	20,49	,50	22,27	,45	27,55	3,24
Height (cm)	176,10	7,38	176,16	7,21	175,22	7,81	178,03	7,00	174,72	7,89
Weight (Kg)	73,41	7,82	71,15	8,39	72,07	9,05	77,12	9,27	73,54	9,00
BMI (kg/m^2)	23,63	2,06	22,91	2,00	23,44	2,20	24,30	2,22	24,03	2,00
1000m race (min)	03:22.25	00:15.02	03:23.30	00:14.39	03:21.96	00:16.49	03:17.37	00:12.99	03:30.33	00:15.69
50m race (s)	6,95	0,47	7,01	,46	6,88	,53	6,84	,43	7,10	,51
2 minutes Push Ups (repetitions)	42,65	11,82	42,82	10,76	42,47	11,99	42,61	11,10	42,69	10,69
Vertical Jump test (cm)	55,22	5,77	53,46	6,89	55,67	7,39	58,21	5,09	53,38	5,73
50m swimming (s)	37,78	7,57	37,67	4,94	38,29	7,81	22,27	,45	39,02	5,73

BMI: body mass index.

Inferential analysis between marks obtained in first and second semesters by age group shows statistical differences for the total sample in the 1000m and 50m race ($p < 0.001$) and in Vertical Jump test ($p < 0.01$) (Table 2). Depending on the age group analysed, statistical differences have been observed, like 2 min Push Ups ($p < 0.001$) for the 18–19 age group, but in the 20–21 age group no statistical differences have been observed for the Vertical Jump test or in the > 24 age group, also no differences have been observed for the 1000m race.

Table 2
Inferential analysis between first and second semester physical fitness tests.

		Mean of the differences					t	gl	p
		Mean	sd	Error	CI (95%)				
					Lower	Higher			
All	1000m race (min)	00:03,881	00:08,202	00:00,633	00:02,630	00:05,130	6,133	167	,001
	50m race (s)	-,15708	,25750	,01987	-,19631	-,11786	-7,907	167	,001
	2 min Push Ups (reps)	-,64634	6,85945	,53563	-1,70402	,41133	-1,207	163	,229
	Vertical Jump test (cm)	-,90854	4,03028	,31471	-1,52997	-,28710	-2,887	163	,004
	50m swimming (s)	,04268	2,49503	,19483	-,34203	,42740	,219	163	,827
18–19 years old	1000m race (min)	00:07,571	00:06,175	00:00,738	00:06,009	00:09,004	10,258	69	,001
	50m race (s)	-,13743	,27653	,03305	-,20336	-,07149	-4,158	69	,001
	2 min Push Ups (reps)	-1,89855	6,70633	,80735	-3,50959	-,28751	-2,352	68	,022
	Vertical Jump test (cm)	-2,17647	3,83986	,46565	-3,10591	-1,24703	-4,674	67	,001
	50m swimming (s)	,15714	2,24987	,26891	-,37932	,69360	,584	69	,561
20–21 years old	1000m race (min)	00:03,773	00:07,370	00:01,111	00:01,532	00:06,013	3,396	43	,001
	50m race (s)	-,17841	,27323	,04119	-,26148	-,09534	-4,331	43	,001
	2 min Push Ups (reps)	-,63415	7,12305	1,11243	-2,88246	1,61416	-,570	40	,572
	Vertical Jump test (cm)	-,88095	4,19757	,64770	-2,18901	,42710	-1,360	41	,181
	50m swimming (s)	,36585	3,27686	,51176	-,66845	1,40016	,715	40	,479
22–23 years old	1000m race (min)	00:04,260	00:07,257	00:01,397	00:07,130	00:01,390	-3,050	26	,005
	50m race (s)	-,16741	,21601	,04157	-,25286	-,08196	-4,027	26	,000
	2 min Push Ups (reps)	-,18519	6,26367	1,20544	-2,66301	2,29264	-,154	26	,879
	Vertical Jump test (cm)	1,55556	3,53372	,68006	,15766	2,95345	2,287	26	,031
	50m swimming (s)	-,25926	1,67774	,32288	-,92295	,40443	-,803	26	,429
24-… years old	1000m race (min)	00:02,630	00:09,013	00:01,735	00:00,940	00:06,195	1,516	26	,142
	50m race (s)	-,16296	,22557	,04341	-,25220	-,07373	-3,754	26	,001
	2 min Push Ups (reps)	2,07407	6,92779	1,33325	-,66647	4,81462	1,556	26	,132
	Vertical Jump test (cm)	-,22222	3,54459	,68216	-1,62441	1,17997	-,326	26	,747
	50m swimming (s)	-,46154	2,43690	,47791	-1,44582	,52275	-,966	25	,343

Table 3 (supplementary material) resumes the physical activity planning in the first and second semester in the academic course 2018–2019. It should be noted that the physical activity planning used at XXXX includes characteristics intended to train and develop those physical fitness aspects (upper limb strength, general resistance, velocity, lower limb strength and swimming performance) associated with the Spanish army physical fitness assessment system.

A correlational analysis between marks obtained in physical fitness tests in first and second semester indicates statistical correlation between all the five tests developed, with a significant statistical positive correlation between 1000m race, 50m race and 50m swimming and between 2 min Push Ups and Vertical Jump test and a significant statistical negative correlation between the three tests 1000m race, 50m race and 50m Swimming and the last two tests 2 min Push Ups and Vertical Jump test ($p < 0.001$). Finally, Fig. 1 shows the VO_2max evolution, calculated based on the results of the 1000m race, by age groups between measurements carried out in the first and second semesters.

Discussion

The objective of this study was to analyse the physical fitness of the cadets enrolled in the five years duration of the Bachelor's degree and Military Training. Our sample includes a real representation of sex percentages between groups in XXXX. The total sample participating in the study was 167 as mentioned in the Results section, but only 8.31% were women. Men and women involved in military service carry out jobs that require a high level of physical fitness despite their age, rank, or job position [4]. Additionally, the physical conditioning of the simple improves with age and the best results could be observed in that subgroup between 22–23 years.

of specificity maintains that the exercise response is specific to the mode and intensity of exercise and that the training program must stress the physiological systems that are critical for optimal performance in the given task to achieve specific training adaptations. There are a variety of fitness assessment tests available for measuring performance or changes in fitness [16]. Restricted training time dictates that certain candidates might not be able to reach or exceed physical fitness tests requirements [4] and, in the case of XXXX cadets, to pass for example the Physical Fitness subject each academic course. The challenge with group physical training is the fact that these groups are not composed of homogeneously conditioned soldiers based on their physical fitness [7].

In the case of the physical training programme developed at the XXXX and responding with the main objective of maintaining and training physical and cardiovascular fitness of cadets and preparing them to the semester physical fitness tests, this programme is organized giving relevance to different aspects of physical conditioning. The content of the programme focuses, in the first semester, in running training (three out of five days), strength power circuit (one day) and swimming (one day). In the second semester, the programme focuses on running training (three out of five days) and strength power circuit (two days), without including the specific swimming training during the second semester. There does indeed seem, therefore, to be coherence between the tests used to access physical fitness and the training programme developed, but not quite, because the larger duration test used in the current battery tests is the 1000m race and that it is supposed to access cadets' resistance, however this test is at the limit of accessing this aspect. In other studies, the VO_2max is accessed based on tests that include a minimum of 1600m [17] and being in some cases 3000m in specific physical fitness protocols [18], in few cases near the 4800m [10], and being the most adopted 2400m used for the American Navy and the British Royal Navy [3, 17]. Wilkinson et al. [19] in their study could observe a direct correlation between the 2400m race and the multistage fitness test, being this, for example, a practical mean to assess aerobic fitness when space is limited. But in the case of the tests carried out in the XXXX the largest distance test used is 1000m and no multistage fitness test is included.

Emphasis in the military has traditionally been placed on the long-distance run, which is one of the simplest and cheapest forms of training that large groups can do in almost any environmental conditions, with little or no formal knowledge or understanding of principles of physical training [7].

In other military Forces, like for example the Norwegian Navy Special Operation Forces, physical training is focused on aerobic endurance, through running and local muscular endurance training (bodyweight circuit training) [7, 18], a situation similar to that carried out in the XXXX. This type of training, as more generally reflected in different public health guidelines, is characterized by prolonged periods of continuous exercise at a moderate- intensity pace [7]. Nowadays, the Norwegian Navy Special Operation Forces is conducting a new approach to fit with new demands and organizational modifications because it has been observed that a combination of mixed endurance-based training, exclusive of any individualization, does probably not provide the optimal stimulus to improve other capacities such as strength and power [18, 20]. The reason for developing a new anaerobic work capacity test for the Norwegian Navy Special Operation Forces was due to the lack of a valid, specific, and easily implemented anaerobic work capacity test for it force operators in the literature. The test simulates the scenario where an operator must run a distance and evacuate a person by dragging him out of the "danger zone." This scenario was chosen because it could be easily replicated, and the movement-pattern, external load, and muscles included are similar to many critical "anaerobic" combat situations [20].

Interval training could be adapted to fit a reality where cadets present different levels of physical fitness and ensure all members of a given unit benefit equally from quality training time that is designed to prepare them for the demands of their missions [7]. In the case of the XXXX physical training programme, it includes, both in the first and in the second semester, one day of interval training, what involves reduced training volume and time as compared with traditional endurance training, as mentioned by Gibala et al. [7], but other approaches are also used, because physical tests evaluate different aspects.

The Army Soldiers in Basic Combat Training and operational units of USA Army participated in the study by Dada et al. [1] and the authors observed an average measure for 2min Push ups of 34.9 ± 14.8 repetitions for the men age group 17–21 and 36.3 ± 14.8 for the men age group 22–26. In our study, age groups for the analysis were different from those in the study by Dada et al. [1], but independently, higher values have been observed, with average values of 42.82 ± 10.76 and 42.47 ± 11.99 for the age groups 18–19 and 20–21, respectively,

and 42.61 ± 11.10 and 42.69 ± 10.69 for the age groups 22–23 and > 24, respectively, but in our case analysis by age group included men and women. In that study, as the APFT has been used to access Physical fitness of sample, a 2 min Sit Ups and a 2-mile (3218.69m) run were included in the measurements. The 2 min Sit Ups are not included in the XXXX fitness tests, as well as the 2-mile run, because the largest run included in the XXXX tests include a 1000m race, and performance on those different running lengths could be remarkably different because they involve different patterns of energy production.

Cuddy et al. [4] in their study conclude that candidates to enter some Special Operations Forces in USA who are completing 30 min per day or more of physical activity have a higher likelihood of passing the Physical Fitness Tests, or at least the run portion. Because the run portion is more difficult to pass compared with the calisthenics, candidates should accumulate 30 min per day of vigorous activity if they wish to have a greater chance of passing the Physical Fitness test. This follows with exercise recommendations put forth by the American College of Sports Medicine to improve health [4].

In the study by Groeller et al. [8] carried out with a simple of 51 Australian soldiers during the basic military training and initial employment training from 5 different specialities (infantry, armoured, combat engineers, artillery and transport trades), physical aspects have been assessed including 2 min Push Ups and Vertical Jump. In the case of Vertical Jump measurement, it has been done using a portable force platform and the force applied has been measured in N, different from the methodology employed in the current work and making data comparison impossible. However, measurement on 2 min Push Ups repetitions reached similar values to ours in the first assessment 41.1cm (37.5–44.7), but values observed after the basic military training 49.7cm (47.0–52.4) and after initial employment training 57.5cm (54.4–60.6) were superior than those observed for our sample (42.65 ± 11.82), a fact that could be explained by a more specific training on this specific ability.

Even considering military naval forces, we have not succeeded in finding bibliography evidence on other physical fitness protocols including swimming in their tests. It is important to stress that we do not consider that, in the case of the XXXX, they consider the physical performance in swimming as a tipping point because there physical training protocol only includes swimming once a week in the first semester and their 50m swimming test has a cut off time to pass over 50s and the average times achieved by the cadets are over 35s.

Conclusion

The level of physical fitness of cadets at the XXXX appears to be at an acceptable level when compared to other countries military naval corps. However, it should be important considering an adjustment in physical training protocol to be more coherent with the physical fitness tests employed and with posterior demands such military personnel will be faced in garrison and deployment environments.

What we authors mean is that it is important not only evaluating physical fitness of military personnel based on tests included in the Physical Fitness Tests Protocol, but also it is important adapting to new situation brought about and to pause and reflecting if current tests used accesses the physical fitness aspect that are supposed to access.

Abbreviations

APFT: Army Physical Fitness Test; BMI: Body Mass Index, USA: United States of America (USA).

Declarations

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Authors' contributions

All authors made substantial contributions to the paper: IM de Oliveira, ME Vila-Suárez, JM Cancela-Carral and FJ Burgos-Martos contributed to the research concept and study design; IM de Oliveira and ME Vila-Suárez contributed to the literature review; IM de Oliveira, ME Vila-Suárez and FJ Burgos-Martos contributed to data collection, data analysis and interpretation; JM Cancela-Carral contributed to statistical analyses; and IM de Oliveira, ME Vila-Suárez and JM Cancela-Carral contributed to the writing of the manuscript, or reviewing/editing a draft of the manuscript.

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Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available considering they are a part of national documents.

Ethics approval and consent to participate

Our research protocol is in accordance with the Helsinki Declaration with respect to data collection and processing (World Medical Association, 2013) and with the Spanish *Ley Orgánica de Protección de Datos de Carácter Personal. This protocol* was submitted for consideration, commenting, guidance and approval to the research ethics committee of XXXX and accepted before the study began with the code number 03-719.

Consent for publication

Not applicable.

Competing interests

The authors declare that there are no competing interests.

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References

1. Dada EO, Anderson MK, Grier T, Alemany JA, Jones BH. Sex and age differences in physical performance: A comparison of Army basic training and operational populations. J Sci Med Sport [Internet]. 2017;20:S68–73. Available from: http://dx.doi.org/10.1016/j.jsams.2017.10.002.
2. Anderson MK, Grier T, Canham-Chervak M, Bushman TT, Nindl BC, Jones BH. Effect of Mandatory Unit and Individual Physical Training on Fitness in Military Men and Women. Am J Heal Promot. 2017;31(5):378–87.
3. Sargent C, Lacey S, Gebruers C, O'Mahony J. The development and optimisation of a quantitative physical fitness scoring system for use amongst Naval Service personnel. Int Marit Heal. 2016;67(3):171–8.
4. Cuddy JS, Slivka DR, Hailes WS, Ruby BC. Factors of trainability and predictability associated with military physical fitness test success. J Strength Cond Res. 2011;25(12):3486–94.
5. Warr BJ, Scofield DE, Spiering BA, Alvar BA. Influence of Training Frequency on Fitness Levels and Perceived Health Status in Deployed National Guard Soldiers. J Strength Cond Res [Internet]. 2013 Feb;27(2):315–22. Available from: https://insights.ovid.com/crossref?an=00124278-201302000-00006.
6. Tingelstad HC, Theoret D, Spicovck M, Haman F. Explaining Performance on Military Tasks in the Canadian Armed Forces: The Importance of Morphological and Physical Fitness Characteristics. Mil Med. 2016;181(11):e1623–9.
7. Gibala MJ, Gagnon PJ, Nindl BC. Military Applicability of Interval Training for Health and Performance. J Strength Cond Res [Internet]. 2015 Nov;29:S40–5. Available from: https://insights.ovid.com/crossref?an=00124278-201511001-00007.
8. Groeller H, Burley S, Orchard P, Sampson JA, Billing DC, Linnane D. How effective is initial military-specific training in the development of physical performance of soldiers? J Strength Cond Res. 2015;29(September 2016):158–62.

9. Bilzon JLJ, Scarpello EG, Bilzon E, Allsopp AJ. Generic task-related occupational requirements for Royal Naval personnel. Occup Med (Chic Ill). 2002;52(8):503–10.
10. Bartlett JL, Phillips J, Galarneau MR. A Descriptive Study of the U.S. Marine Corps Fitness Tests (2000–2012). Mil Med. 2015;180(5):513–7.
11. Mackey CS, Defreitas JM. A longitudinal analysis of the U.S. Air Force reserve officers' training corps physical fitness assessment. Mil Med Res. 2019;6(1):1–8.
12. Wyss T, Von Vigier RO, Frey F, Mäder U. The Swiss Army physical fitness test battery predicts risk of overuse injuries among recruits. J Sport Med Phys Fit. 2012;52(5):513–21.
13. Williamson DA, Bathalon GP, Sigrist LD, Raymond Allen H, Friedl KE, Young AJ, et al. Military Services Fitness Database: Development of a Computerized Physical Fitness and Weight Management Database for the U.S. Army. Mil Med. 2009;174(1):001–8.
14. Ross WD, Marfell-Jones MJ. Cineantropometría. In: Macdougall DJ, Wenger HA, editors. Evaluación fisiológica del deportista. Barcelona: Paidotripo; 2013.
15. MADOC España. MV3-101. Manual del Sistema de Evaluación Física Individual del Ejército de Tierra. 2010.
16. Grier TL, Canham-Chervak M, Bushman TT, Anderson MK, North WJ, Jones BH. Evaluating Injury Risk and Gender Performance on Health- and Skill-Related Fitness Assessments. J Strength Cond Res. 2017;31(4):971–80.
17. Lunt H, Roiz De Sa D, Roiz De Sa J, Allsopp A. Validation of One-Mile Walk Equations for the Estimation of Aerobic Fitness in British Military Personnel Under the Age of 40 Years. Mil Med. 2013;178(7):753–9.
18. Solberg PA, Paulsen G, Slaathaug OG, Skare M, Wood D, Huls S, et al. Development and Implementation of a New Physical Training Concept in the Norwegian Navy Special Operations Command. J Strength Cond Res [Internet]. 2015 Nov;29:S204–10. Available from: https://insights.ovid.com/crossref?an=00124278-201511001-00035.
19. Wilkinson DM, Blacker SD, Richmond VL, Rayson MP, Bilzon JLJ. Relationship Between the 2.4-km Run and Multistage Shuttle Run Test Performance in Military Personnel. Mil Med. 2014;179(2):203–7.
20. Angeltveit A, Paulsen G, Solberg PA, Raastad T. Validity, Reliability, and Performance Determinants of a New Job-Specific Anaerobic Work Capacity Test for the Norwegian Navy Special Operations Command. J Strength Cond Res [Internet]. 2016 Feb;30(2):487–96. Available from: http://insights.ovid.com/crossref?an=00124278-201602000-00024.

Figures

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Figure 1

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