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The Cadet Athlete Physical Training Intervention (CAPTI): A 16-week Periodized Program to Remediate Underdeveloped Tactical Athletes at a Senior Military College

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ABSTRACT

International Journal of Exercise Science 17(4): 1083-1091, 2024. Approximately half of military recruits fail the Army Physical Fitness Test (APFT), and 70% of all injuries in the US military are musculoskeletal in nature. The purpose of this study was to investigate whether underdeveloped musculoskeletal and cardiovascular fitness levels and subsequent APFT scores of senior military college cadets could be improved by a novel, evidence-based Cadet Athlete Physical Training Intervention (CAPTI) compared to the current Remedial Physical Training program (RPT). Cadets failing the APFT (total score < 180, or < 60 in scored sit-ups, pushups or run time, respectively) participated in a 16-week remedial training program including either CAPTI (periodized full body calisthenic and varied-technique cardiovascular training, along with mobility training and mental health and wellbeing sessions), or a traditional, event-specific remedial training program (RPT). CAPTI was randomly assigned to one of three battalions, while the others received RPT. One hundred and thirty-eight cadets (n = 70 CAPTI, n = 68 RPT) participated in the study. After training, 82.9% (n = 58) of CAPTI passed the APFT compared to 27.9% (n = 19) of RPT. Paired t-tests demonstrated significant improvement ($p < 0.01$) for CAPTI in total APFT scores (42 ± 31.5 points), sit-ups (13.8 ± 9.4) pushups (6.5 ± 11) and run time (83 ± 123s). In RPT, significant improvements ($p < 0.01$) were noted in total APFT scores (16 ± 27.8), sit-ups (3.3 ± 6.7) pushups (3.69 ± 8.0) and run time (43 ± 127s). Between-group analyses demonstrated CAPTI had significantly higher improvements compared to RPT in APFT total score ($p < 0.01$) and sit-ups ($p < 0.01$). Higher perceived program enjoyment was also demonstrated for CAPTI when compared to RPT ($P < 0.01$). The CAPTI program could help address the military's physical readiness and musculoskeletal injury problem by incorporating evidence-based, wellness-focused, periodized training as part of a remedial physical training model.

KEY WORDS: Muscle health, strength, conditioning

INTRODUCTION

Physical fitness is a crucial component of US military readiness, as the daily occupations of most active-duty service members require some form of athletic capability (12). Upon entering the military, basic trainees must pass a physical fitness test specific to their branch of service as well as pass some form of height and weight standard (5). Recently, service members have been

referred to as "tactical athletes", a term that identifies the athletic nature of their profession and highlights the need for unique occupational training strategies (7, 12).

Recent reports demonstrate a deficient level of physical readiness in the United States civilian population, however, leading to issues of recruitment and retention in the military. Lack of physical activity, a rising prevalence of obesity, and poor diet are cited as contributing factors barring American military-aged adolescents and young adults from service (16, 18, 20). Furthermore, poor training outcomes, injury, and attrition from service, are consequences of deficient physical conditioning once in the military, due to either underdevelopment of musculoskeletal structure, reduced cardiovascular capability, or impaired body composition (4). In response to this emerging national security crisis, a report by the Department of Defense (DoD) published in March 2023 concluded that the Military Health System must "reshape its focus on disease and injury treatment and prevention to embrace health enhancement for optimal human performance in a technology-rich battle space" (17). As such, the DoD has enacted "Total Force Fitness" (TFF) (21) which encompasses evidence-based training for the physical, mental, social and spiritual aspects of fitness. Similarly, the Army has instituted "Holistic Health and Fitness" (H2F) (5), which is directed by FM7-22 (5) and includes newly written initiatives on periodized and progressive physical training (section 7-1 and 7-2) and specifically addresses reconditioning (section 12-1), which highlights the need for expert led programming guided by evidence-based training strategies. And while physical readiness is a priority for these initiatives, they each also address multiple pillars of wellness which serve to improve the psychological readiness of military-aged individuals with one strategy being increasing physical activity enjoyment and participation (10, 20).

However, addressing many of these issues upon enlistment or commissioning may be ill timed, with evidence that healthy behavior interventions are more persistent if initiated earlier in life, particularly during college (3). Given the robust training pipeline for military leaders, there are multiple opportunities to intervene prior to active-duty service. Senior military colleges (SMCs) are institutions designed to train future military officers that graduate with a 4-year degree. Enrollment at a SMC provides an opportunity for students, known as cadets, to live in a garrison-type environment and participate in physical and mental training throughout their residency. Upon arrival to SMCs, cadets participate in basic assimilation to a military lifestyle, including rigorous physical training, learning of technical skills, and leadership development. After initial assimilation, cadets at SMCs actively participate in a full academic load, and live in a militaristic lifestyle that requires tactical, physical, and mental training as part of everyday life. Yet, the physical readiness problems seen in the US civilian population are also representative of the cadet population at SMCs. Like in military service, cadets are expected to pass a physical fitness test (PFT) annually. According to previous records maintained at the study site, more than half (approximately 65–70%) of cadets fail the PFT annually. When a cadet or military recruit fails their PFT for the first time, they are often assigned to a remedial physical training (RPT) program and required to attend additional physical training sessions to increase musculoskeletal and cardiovascular capabilities. However, RPT programming has historically not been based upon the evidence-based principles of reconditioning that are described in the Physical Readiness section of the H2F manual (5).

The primary purpose of this study was to investigate whether underdeveloped musculoskeletal and cardiovascular fitness levels, and subsequent Army Physical Fitness Test (APFT) scores of senior military college cadets, could be improved by a novel, evidence-based Cadet Athlete Physical Training Intervention (CAPTI) that was based upon section 12-1 ("Physical Readiness") of the H2F manual (5), compared to a typical non-evidence based Remedial Physical Training program (RPT). A secondary purpose of the study was to identify whether participant enjoyment differed between the new CAPTI program compared to the traditional RPT program.

METHODS

This retrospective cohort design evaluated a 16-week training period at an SMC to examine changes in physical fitness test (PFT) scores of cadets receiving CAPTI compared to RPT. Physical training was conducted in a field setting, and data collection was conducted by the SMC cadet training staff as part of SMC standard operating procedures (SOP). Ethical policies related to scientific discovery in exercise science were followed by the research team in accordance with the *International Journal of Exercise Science* policies (11). Participants were not required to sign an informed consent, as data collection occurred as a part of standard operating procedures on campus and the study design was a retrospective review. The Norwich University Institutional Review Board determined this study to be exempt.

Participants

Participants for this study were included if they were first year cadets assigned to remedial physical training program after failing the initial APFT. The CAPTI program was randomly assigned to one of three cadet battalions (BN) while the other two received the standard RPT program.

Protocol

The Cadet Athlete Physical Training Intervention involved a 16-week (3 sessions per week) periodized full body calisthenic and varied-technique cardiovascular training program that also included weekly 10–15-minute lessons on various well-being topics (physical training programming, mental health and stress management techniques, functional movement screens, nutrition, dietary supplementation, and recovery and injury prevention; Figure 1). The training staff for CAPTI received instruction from the lead cadet physical trainer, who was overseen by a subject matter expert faculty member. Each session was led by the same team of physical trainers, who were assigned to only lead CAPTI and not RPT. Sessions were completed three times per week and were separated in two 25-minute exercise bouts, with a 10-minute rest in between. The first exercise bout involved compound exercises, plyometric exercises, isometric exercises and rotational stability exercises. During the 10-minute rest, short lessons were taught that addressed health and fitness-related education (Figure 1). In the second exercise bout, cardiovascular training (CVT) was performed consisting of combination middle-distance steady state running on grass, pavement, and turf, along with uphill repeats, short-distance cross country running, and sprint repeats.

The Remedial Physical Training program participated in a 16-week (2 days per week) event-specific, non-periodized program that focused on cardiovascular training and bodyweight resistance training (RT). Every training session was led by the same team of physical trainers, who were assigned to only lead RPT and not CAPTI. Sessions were primarily combination CVT and RT workouts lasting for 50-minutes, following a Tabata protocol (15). The RT exercises included test related body weight exercises (i.e., variations of pushups and sit-ups) and were always performed at similar high repetition counts. CVT consisted of middle-distance steady state running on flat pavement.

To assess changes in physical performance status, all subjects performed the Army Physical Fitness Test (APFT) in accordance with the institution's Physical Training Policy. The APFT (5) is comprised of three events: two minutes of pushups for maximum repetitions, two minutes of sit ups for maximum repetitions, and a two-mile run for fastest time. There are set minimum and maximum repetition counts and run times for each age group, equivalent to points on a 0-100 scale, for both males and females. The institution's policy requires cadets to achieve 60 out of 100 points in each event to pass. Additionally, cadets from both CAPTI and RPT completed a survey of novel questions (Table 1) using a Likert Scale (1 = strongly disagree, 5 = strongly agree; Total Score: 18–45) to understand program enjoyment. Schedule of training, testing, and course topics are outlined in Figure 1.

Statistical Analysis

Paired student's *t*-tests were used to analyze differences within groups, and student's *t*-tests were used to compare mean differences between participants assigned to CAPTI versus RPT. Analyses were conducted on overall PFT score and both the point score and repetition count or run time for each of the three events. All statistical tests were conducted utilizing IBM SPSS Statistics (Version 29).

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CVT		x	x	x	x			x			x		x		x	
RT		x	x	x	x			x			x		x		x	
MOB	x						x		x		x	x	x		x	
REST						x				x						
½ TEST														x		
Full TEST																x
Class Topic	Self Contract		Goal Setting		Periodization		Love for Fitness		Nutrition & Supplements		Recovery		Motivation		Willingness to Change	

Abbreviations: Cardiovascular Training (CVT); Resistance Training (RT); Mobility Training (MOB); No training (REST); Practice Army Physical Fitness Test (1/2 TEST); Full Army Physical Fitness Test (Full TEST)

Figure 1. Schedule of training, testing, and course topics in the 16-week CAPTI program.

Table 1. Questions related to enjoyment of remedial training program vs training alone using a Likert Scale (1 = strongly disagree, 5 = strongly agree).

CAPTI/RPT Enjoyment	Exercise Alone Enjoyment
I enjoy participating in RPT	I enjoy exercising on my own time
I feel like RPT helps improve my physical fitness	I like to go running on my own time
I enjoy formation runs with my regular unit	I have fun exercising outside of RPT
RPT makes me feel like I got a good workout	Running I do with my unit and not RPT is helpful
I believe that RPT is helping my performance on my PT test	Doing exercise on my own time has given me skills that will help me stay fit for a lifetime
Having the military fitness staff present during RPT is helpful	I am motivated to stay physically fit as a result of my own exercise routine
The exercises I do at RPT are fun	I learn a lot about fitness through exercising on my own
The training at RPT has given me knowledge that will help me stay fit for a lifetime	My own exercise routine improves my performance on my PT test
I enjoy RPT	When I do my own exercise routine, I feel like I get a good workout

RESULTS

One hundred and forty (n = 140) first year cadets were included. Participants were age 18–24 years old and included n = 117 males and n = 23 females. After review, two cadets were excluded from the study as they did not complete the full program. All baseline and post-intervention outcomes are reported in Table 2.

After training, 82.9% (n = 58) of CAPTI passed the APFT compared to 27.9% (n = 19) of RPT. Paired t-tests demonstrated significant improvement ($p < 0.01$) for CAPTI in total APFT scores (42 ± 31.5 points), sit-ups (13.8 ± 9.4) pushups (6.5 ± 11) and run time (83 ± 123s). In RPT, significant improvements ($p < 0.01$) were also noted in total APFT scores (16 ± 27.8), sit-ups (3.3 ± 6.7) pushups (3.69 ± 8.0) and run time (43 ± 127s). Between-group analyses demonstrated CAPTI had significantly higher improvements compared to RPT in APFT total score ($p < 0.01$, Cohen's d = 0.8) and sit-ups ($p < 0.01$, Cohen's d = 1.3) but not pushups (p = 0.08) or run time (p = 0.06). In a subset of participants, (n = 5 CAPTI, n = 6 RPTo). Higher perceived program enjoyment was also demonstrated for CAPTI when compared to RPT ($p < 0.01$, Cohen's d = 2.99). Whereas RPTo participants preferred to exercise alone (Table 2).

Table 2. Demographics and Army Physical Fitness Test scores at Baseline (Test 1) and Post-Intervention (Test 2) across the two groups as demonstrated by Student's *t*-test.

	CAPTI (n = 70)	RPT (n = 68)
Age	18.1 yrs	18.5 yrs
Sex (Male)	n = 59	n = 56
Baseline (Test 1) Mean (SD)		
Pushup (reps)	41.4 (15.5)	38.6 (14.6)
Pushup (score)	63.9 (19.9)	61.2 (18.7)
Sit-up (reps)	42.9 (12.8)	45.2 (14.2)
Sit-up (score)	43.8 (20.3)	48.1 (20.8)
2 Mile Run (minutes)	16.8 (3.4)	17.4 (3.6)
2 Mile Run (score)	58.2 (34.3)	51.4 (34.0)
Total APFT Score	166.0 (53.3)	161.0 (48.9)
Number Passed	n = 0	n = 0
Post-Intervention (Test 2) Mean (SD)		
Pushup (reps)	47.9 (12.6)	42.3 (14.9)
Pushup (score)	72.7 (14.9)	66.1 (17.6)*
Sit-up (reps)	56.8 (11.1)	48.4 (14.4)
Sit-up (score)	66.1 (17.9)	53.4 (21.1)*
2 Mile Run (minutes)	15.4 (1.9)	16.7 (3.1)
2 Mile Run (score)	70.6 (22.9)	57.5 (30.3)*
Total APFT Score	208.3 (42.4)	177.0 (53.1)*
Number Passed	n = 58	n = 19*
CAPTI/RPT Enjoyment	37 (1.6)	21 (7.4)*
Exercise Alone Enjoyment	28 (6.4)	35 (8.2)

CAPTI = Cadet Athlete Physical Training Intervention; RPT = Remedial Physical Training Program; APFT = Army Physical Fitness Test; Reps = Repetitions; SD = standard deviation; * indicates significance ($p < 0.05$).

DISCUSSION

The purpose of this study was to investigate whether underdeveloped musculoskeletal and cardiovascular fitness levels and subsequent Army Physical Fitness Test (APFT) scores of senior military college cadets could be improved by a novel evidence-based training compared to a typical non-evidence based remedial physical training program. CAPTI subjects who participated in the full 16-week periodized program demonstrated significantly increased scores in pushups and run time when compared to baseline. When compared to the control program (RPT), CAPTI subjects demonstrated significantly higher total APFT scores and sit-ups. In addition, the participation of CAPTI subjects in the weekly lessons on well-being topics yielded a greater increase in enjoyment of PT with their unit when compared to RPT subjects.

Periodized, progressive training has previously demonstrated significant improvement in fitness gains for tactical athletes when combined with nutritional information and mental readiness education (2, 7, 14). Heilbronn et. al. (9) noted that periodized programming in trained tactical populations resulted in significantly greater ($p < 0.05$) musculoskeletal strength when

compared to a non-structured physical training program. Specifically, non-linear periodization appears to be optimal when programming for tactical athlete units, as there is more flexibility to work around possible interruptions to training time (14).

However, there is a lack of research in which periodized physical training programs have been applied to 1) cadet populations and 2) remedial physical training programs for cadets or active-duty tactical athletes. This is despite recent reports that cadets are seeking information on exercise programing and injury prevention (19). The current results in remedial cadets demonstrate that, similar to active-duty populations, CAPTI participants following a non-linear periodized training regimen demonstrated significant improvement in APFT scores when compared to RPT. Consequentially, the results of this study indicate that this novel approach to remedial physical training in future warfighters is important, as increased PT scores lead to increased service member retention (16), indicate a higher level of readiness in service members (18) and reduce skeletal muscle injury in service members (4).

Moreover, the combination of physical training and well-being education resulted in increased program enjoyment and overall participation. Gubata et. al. (8) noted that incidence of mental disorder in new military personnel (i.e. recruits in training) increased with the incidence of PT test failure, while decreased recording of mental illness was demonstrated in those who were physically fit. Similarly, Ahn et. al. (1) found that cadets with lower fitness levels also demonstrated lower mood states, while more fit cadets had higher mood states. Increases in these areas are of particular interest to military officials, as they may serve to address the poor mental health status of military-aged individuals by increasing physical activity enjoyment, participation, retention, and success (17, 18).

There are several strengths to the current design of this study. To the authors' knowledge, this paper is the first to detail a remedial physical training program within the senior military college (SMC) cadet population, particularly in the United States. Additionally, the interventions used in this study can be applied to non-SMC populations, with the benefit of having a control group to measure against. Finally, the intervention in this study can be enacted without the use of resistance training equipment (I.e., machines and weights) or technological assistive devices (I.e., workout tracking applications, cell phones, smartwatches, etc.), and is easily scaled to match the training needs of any size unit within any given time frame.

These strengths are important as they present support for the repeatability of this study. However, there are certain limitations that must be addressed. In retrospective analysis, CAPTI training sessions were held three days per week, while RPT was held only twice per week. While not in the design of the study and not purposefully randomized, this difference in training session frequency could have implications within the results; however, both RPT and CAPTI had separate control groups, to which intervention was compared. Additionally, members of both the research team and the physical training teams had no control over outside exercise stimuli, and therefore had no way to know if there were additional benefits or overtraining. However, it should be noted that all subjects within the study participated in similar physical training outside of RPT or CAPTI sessions, as required by the SMC they attend.

By addressing the physical fitness deficits demonstrated in military-age adolescents and young adults in the United States, improvements in performance and training mission capability could be seen similar to the benefits demonstrated by the DoD's TFF and Army's H2F (FM 7-22) programs. At SMEs CAPTI is a viable first step in combatting the unreadiness epidemic facing future warfighters. If used for all remedial training, CAPTI or similar programs could yield great positive benefits in the physical fitness of future warfighters, reducing injury and readiness deficits, and increasing enjoyment of physical training. Future research evaluating this program should investigate whether training for longer periods of time per session, more sessions, or for a longer program duration would increase the overall performance of individuals assigned to an evidence based reconditioning program.

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