Mini-Review and Systematic Review

Combat tasks and physical readiness of military personnel: a systematic review

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Abstract - Aim: The physical requirements of a military career reinforce the need for specific physical preparation for the work activities. Thus, combat tasks have been used in the planning and evaluation of training methods that objectify the physical readiness of military personnel. The aim of this review was to identify the physical training methods that improved the physical readiness of military personnel by evaluating combat tasks. **Methods:** A systematic review was carried out in the PubMed, Embase, and Web of Science databases. Guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis, a full analysis was conducted of the final sample. **Results:** The results analysis initially highlighted the sample, the physical training methods applied, and the results obtained with relation to the combat tasks evaluated. After that stage, the data related to the training variables were highlighted (duration, frequency, volume, intensity, and periodization). **Conclusion:** Strength, functional, and physical readiness training programs seems to improve better the performance of military personnel in combat tasks. The periodization of the physical training and the total training volume appear to have a direct relationship with the difference in performance between the groups evaluated and the improvement in physical readiness of the tactical athletes.

Keywords: functional physical performance, training program, physical training, military, occupational health.

Introduction

The recent categorization of military personnel and public security agents as a specific type of athlete - tactical athletes - places more emphasis on the use of the theory and methodology of training, in the physical aspect, for improving occupational performance in these professions[1,2]. The requirements of a military career reinforce the need for physical training and a specific training methodology for the work activities[3]. However, questions related to the objectives and methods of a specific physical training protocol for tactical athletes have not yet received a unison response.

Traditional military physical training sessions last around an hour and the weekly frequency varies between three and five times a week. Their methodological approach ignores the planning, organization, and structuring of training loads, known as periodization, and the physical training sessions are composed of calisthenic exercises, long-distance and low-intensity running, and sporting activities (collective games and ball sports)[4-6]. Although they are related with maintaining health and individual well-being, these activities contribute little to increasing or maintaining the troop's readiness levels[6].

Countries such as the United States, Finland, and Australia have discussed the implementation of training programs guided according to the actions that will be used in the battlefield[7-9]. These actions - known as combat tasks - can be defined as a set of critical physical techniques, skills, and performance for the employment of an operational function and measurement of a troop's readiness states[10]. Combat tasks are directly related with the mission or the specific operational employment of each troop and they can involve, for example, exiting moving vehicles, climbing, barrier-crossing, transporting the injured, and marching with loads[6].

The use of these actions in the planning and evaluation of the physical training of military personnel corroborates with the principle of training specificity and enables the orientation of training loads[11]. Thus, the effect of physical training methods based on specific work tasks - non-conventional military physical training methods and physical readiness training - have obtained positive effects in improving the troop's performance in combat tasks, in occupational health, and in its state of readiness[6,9].

In general, training sessions that objectify physical readiness improve the soldier's general physical aptitude, prevent injuries, and develop self-discipline and confidence. In this physical training modality, physical apti-

tude is subdivided into three guiding axes of the training program: strength (anaerobic resistance and muscle strength), mobility (flexibility, coordination, balance, and agility), and resistance (cardiorespiratory conditioning)[6,12]. Thus, physical readiness training sessions follow the principles of sports training (progressive overload, regularity, and specificity) and are designed to improve performance in combat tasks, helping to increase individual physical readiness and prevent injuries when compared with traditional training programs[6,13,14].

Recent review studies have investigated the evidence related to non-conventional military physical training methods and performance in physical conditioning tests and combat tasks[15-17]. However, although the effect of implementing these methods has been positive for physical readiness and combat task performance, the training variables related to applied interventions (duration, frequency, volume, intensity, and periodization) in samples composed only of military personnel and with positive effects of the intervention on combat task performance have yet to be studied. Thus, this review aimed to conduct a systematic review to answer the following question: "Which physical training methods improve the performance of military personnel in combat tasks?"

Methods

This systematic review was conducted according to the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses)[18] recommendations, and the databases consulted were PubMed, Embase, and Web of Science. The protocol of this systematic review was registered in the PROSPERO (International Prospective Register of Systematic Reviews) platform under registration number CRD42022295892.

The studies that met the PICO (Population: military, Intervention: non-traditional physical training, Comparison: traditional physical training, and Outcome: improved performance in combat tasks) criteria, were considered eligible and included in this review.

Search strategy

Based on the determination of the scope for the review and on a preliminary review, a list of recurrent terms was identified for this review. Thus, combinations and variations of the following terms were used: ((physical training) AND (task) AND ((warfighter) OR (military) OR (military personnel) OR (soldier))). The bibliographical references of all the studies included were also used as consultation sources, adding all the articles that could be included in this review. The database searches were carried out in the months of February and March of 2022 and were updated between July and August 2023.

Inclusion and exclusion criteria for studies

The inclusion criteria to be adopted were: 1) full original articles; 2) sample composed of healthy military personnel; 3) detailed physical training protocols; 4) performance evaluation based on combat tasks; 5) an explicit indication in the text of the relationship between the training protocol and combat tasks; and 6) the results of the application should be clearly presented.

In addition, we excluded articles: 1) that did not describe in detail the physical training methodologies employed; 2) that did not present a control group; 3) whose sample was not only composed of military personnel; and 4) whose studies did not describe the combat tasks evaluated.

Data extraction

The articles were chosen primarily by analyzing their titles and abstracts; next, these studies were read in full. The chosen articles were subjected to an exploratory analysis of the full text, followed by an in-depth selective analysis of relevant parts. The data extracted from the articles (authors, title, journal, abstract, and conclusions) were recorded to order and summarize the material to be able to obtain the information relevant to the study objectives. The data extraction was carried out independently by two reviewers. When there was disagreement, the full text was reanalyzed and, when the discrepancies persisted, a third reviewer was called upon to resolve them[18].

Methodological quality evaluation

The methodological quality of each study included was screened using the PEDro scale, with the general score per study being reported as a sum[19]. It warrants mentioning that, due to it not being possible to blind the participant during a physical training intervention, the PEDro criterion "there was blinding of all subjects" was removed from the methodological evaluation. Thus, the methodological quality was scored out of a maximum of 10: excellent (8-10); good (5-7); fair (3-4); and poor (<3)[19]. The methodological quality evaluation was also carried out independently by two reviewers and, similarly, if there were any discrepancies, a third reviewer was called upon to resolve them[18].

Results

The database search resulted in 957 articles. After removing duplicates, which was carried out using the Rayyan software, a total of 719 studies were obtained. Of that total, 693 studies were excluded based on reading the title and/or abstract, thus leaving 26 papers, which were read in full. After applying the inclusion criteria, eight studies were considered in this review (Figure 1). All the articles chosen presented a score equal to or higher than 5 on the PEDro scale (Table 1).

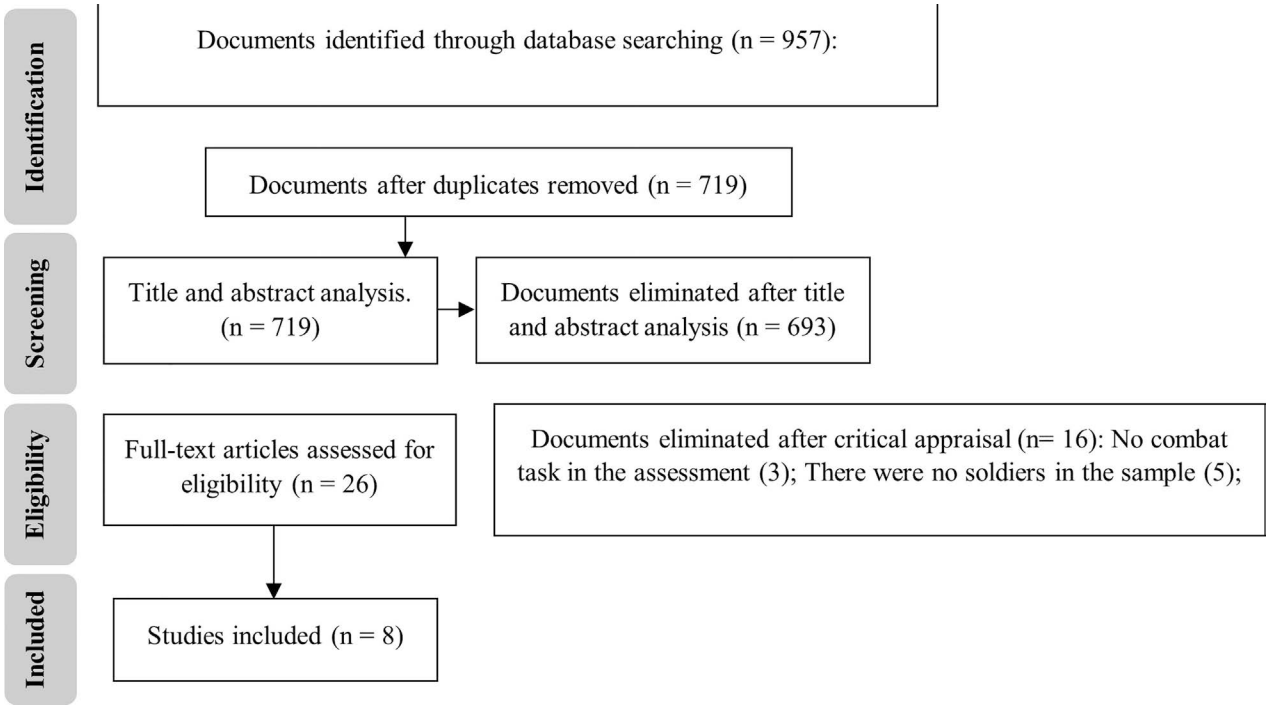

Figure 1 - The selection process (Following PRISMA guidelines, Moher et al.[18].

The eight articles were read analytically and selectively, as shown in Table 1. The following information was considered relevant: first author; year of publication; study population; type of physical training carried out with the intervention group and with the control group; total intervention time; outcomes evaluated (only related to combat tasks); evaluation methods used; results; and, finally, the score on the PEDro scale. In addition, we extracted from the chosen articles the methodological data from the physical training programs employed (Table 2), including only the interventions that used non-conventional military physical training methods.

Table 1 - Included studies, groups, outcome and methodological quality.

Author, year	Participants	Groups	Results	PEDro scale
Burley et al. (2020)	147 Australian Army recruits (Male, Female)	EG: Low-volume and High-Intensity concurrent Training CG: Basic Military Training	3.3 km load carriage (22 kg): Greater improvement in EG compared to CG (-156 s, -106 s); 1RM box lift, 1.5 m height: EG: increased (+4.8 kg); CG: increased (+1.3 kg); Greater improvement in EG compared to CG	6/10
Heilbronn et al. (2020)	49 Australian Army Soldiers (Male)	EG1: Periodized resistance training EG2: Non-periodized resistance training CG: Traditional Training without resistance training	2.4 km Loaded Run: no changes; 5.0 km loaded march: EG1 decreased time -12.4%, EG2 decreased time -11.8%, CG: no changes. Simulated Fire and Movement: Greater Improvent RT groups when compared with CG.	6/10
Lester et al. (2014)	133 US Army Soldiers (Male)	EG: Novel Physical training program CG: Traditional army physical fitness training	30 m Rush: EG was superior to CG (5 vs. 1%); Casualty rescue (50 m - 175 lb): EG was superior to CG (17 vs. -15%).	5/10
Newman et al. (2022)	35 US Army ROTC Cadets (Male, Female)	EG: High-Intensity Functional Training CG: US Army Readiness Training Program	Was no significant difference between groups. 1600-m Weighted Run: ~3%; Sprint-Drag-Carry: ~9%.	6/10
Ojanen et al. (2020)	42 Soldiers of Finnish Defense Forces (Male)	EG1: Task-Specific EG2: Strength Training CG: Traditional Physical Training	EG1 was as effective as EG2: to improve repeated simulated military task. Total Time Military Task Circuit: Improved significantly in EG1 and EG2 between the PRE and MID measurements (from 9.4 to 15.7%).	6/10

(*continued*)

Table 1 - continued

Author, year	Participants	Groups	Results	PEDro scale
Pihlainen et al. (2022)	78 Peacekeeping Soldiers (Male)	EG1: Strength and Endurance Training EG2: Strength and Endurance Training (strength emphasis) EG3: Strength and Endurance Training (endurance emphasis) CG: Free Practice	All groups improved their MST (military simulation test) time. No differences in the changes in MST were observed between the experimental groups and CG.	6/10
Santilla et al. (2010)	63 Conscripts of Finnish Defense Forces (Male)	EG2: Strength Training CG: Traditional Physical Training CG: Basic Training	3 km Load carriage (14.2 kg): EG: -12.4%, EG2: -11.6%, and CG: by -10.2%.	6/10
Vaara et al. (2015)	25 Conscripts of Finnish Defense Forces (Male)	EG: Special Military Training with Added Strength Training CG: Special Military Training	3.2 km load carriage (27 kg): EG: -9.9%% and CG: -9.4%. No differences between groups.	7/10

EG: Experimental Group, CG: Control Group.

Table 2 - Methodological characteristics of non-traditional physical training programs.

Author, Year	Duration [weeks]	SD [min]	Freq. (days/ week)	TS	Group	Physical training details
Burley et al. (2020)	12	~75	3-4	40	EG	Total volume of training was 3005 min with 17 resistance training sessions, 8 high-intensity running, 2 load carriage, 3 familiarization sessions, 2 swimming, 3 fitness testing, 2 ropes sessions, 3 obstacle course
Heilbronn et al. (2020)	9 (over 15)	90	5	45	EG1	Week routine: Day 1 aerobic session, Day 2-4 strength/power/endurance session + Resistance Training + HIIT, Day 3 recovery session and, Day 5 military endurance enhancement session (loaded march).
					EG2	Non-periodized resistance training: Weeks 1-9 = 4 x 6 85% 1RM (2-min recovery between sets).
Lester et al. (2014)	7	~90	5	35	EG	Week Routine: 4 Core Training sessions, 2 Resistance Training sessions, 2 Aerobic/Strength/Power Sessions, 1 Loaded carriage session and, 5 Flexibility sessions.
Newman et al. (2022)	10	60	~3	27	EG	3 different training sessions per week: Strength, Anaerobic, Conditioning, Power or, Speed/Agility.
					CG	Circuit Training which involves Drills, Carrys, full gear exercises and, simulated tasks.
Ojanen et al. (2020)	12	60	~2	18	EG1	Basic infantry-based exercise with full combat gear which involves Drills, Carrys, full gear exercises, crawling and, casualty drag.
					EG2	Non-linear strength training program. There were four to five different exercises (e.g., squat, deadlift, bench press and different push, and pull exercises for upper body).
Pihlainen et al. (2022)	19	~60	4	76	EG1	Performed a periodized training routine with 2 strength and 2 endurance training sessions per week.
					EG2	Performed a periodized training routine with 3 strength and 1 endurance training sessions per week.
					EG3	Performed a periodized training routine with 1 strength and 3 endurance training sessions per week.
					CG	Performed training of their choice.
Santilla et al. (2010)	8	60-90	3	24	EG1	Total of 44 h strength training sessions. Whole body linear periodized strength-training program, gym and circuit training, each training session always included two exercises for leg extensor muscles.
					EG2	Total of 51 h aerobic training sessions, which included nordic walking, walking, running, bicycling, and some other endurance exercises.
Vaara et al. (2015)	8	60	2	16	EG	Speed of movement was moderate for hypertrophic training and maximal for maximal strength and power training.

SD: Session Duration; Freq.: Frequency; TS: Training Sessions; EG: Experimental Group, CG: Control Group; HRR: Heart Reserve Rate; RM: Maximum Repetition.

Discussion

This study aimed to verify the physical training methods that improved the physical readiness of military personnel through a combat task evaluation. The search for studies conducted solely with military samples aims to obtain data applicable in this occupational environment. The permanent availability for work 24 h a day and seven days a week, the uncertainty of the next mission, and the need to apply physical attributes in minimally ideal conditions mean that the effects of physical training programs conducted in populations that do not follow this work routine cannot be generalized[20].

Thus, we verified variables related to the type of training program, periodization model, and duration and frequency of the interventions in the physical training of the tactical athletes.

Training programs

The training programs applied in the included studies (Table 2) can be divided into four training groups: strength, functional, aerobic, and physical readiness (physical readiness training[21] or task-specific training[22]).

Strength training or resistance training involves the performance of physical exercises that are designed to improve strength and increase lean body mass without gaining fat[20]. In general, the addition of strength training programs in the military training routine presented an improvement in the performance of tasks such as backpack marching, operational circuits, weight carrying tasks, and transporting the injured, which was significantly better than in the groups that carried out traditional military physical training programs[9,23,24]. When strength training was applied with a lower training frequency (two days a week), it did not obtain a significantly better performance increase than traditional physical training. In this case, the authors suggest that the military training period called "special training" - characterized by various displacements with backpacks and combat equipment - would have increased the performance of the control group in this type of task[25]. Yet, a prolonged intervention time (12 weeks) and a similar weekly frequency were able to cause significant adaptations in combat task performance with relation to the control group[22]. This suggests that strength training programs with lower weekly training frequencies need a more prolonged intervention to generate significantly positive adaptations in combat task performance. In the studies that also had aerobic training and physical readiness training experimental groups, strength training obtained similar increases in combat task performance to these other two groups[22,24,26].

Functional training "programs are generally characterized by physically and metabolically demanding circuit workouts consisting of resistance, plyometric, and interval running exercise"[20]. The use of functional training in military physical training sessions can improve the physical conditioning and body composition of military personnel, requiring a lower volume of exercises and a shorter duration of training sessions[21]. Thus, this type of intervention presented a significant improvement in combat task performance with relation to traditional military physical training (30 m sprinting and transporting the injured)[27]. However, although it improved backpack marching and operational circuit performance, it did not obtain significant differences when compared with physical readiness training (the current physical training program of the US army)[21].

Typically, vigorous exercise that challenges the aerobic system, such as running, cycling, swimming, and walking, is called aerobic training[20]. Only one of the studies chosen for this review carried out an intervention exclusively related to aerobic training. This intervention resulted in a performance improvement in a 14.2 kg backpack marching task, but there was no significant difference between the groups studied (traditional training, strength training, and aerobic training)[24]. Comparing with other studies that used heavier loads in this same task[9,25] (22 and 27 kg, respectively), the sensitive differentiation in the performance improvement between strength training, aerobic training, and the control group may be explained by the lighter load and by the low displacement volume in this combat task (approximately 3 km). In addition, the aerobic training program used a significantly higher training volume (51 h) than the strength training (44 h) and conventional training (33 h)[24], which therefore does not justify the intervention for improving backpack marching performance.

Finally, the physical training programs based on the occupational tasks and physical readiness of military personnel obtained similar results when compared with functional training or with strength training[21,22]. These results were obtained through the execution of a run with combat equipment (1600 m) and operational circuits, and when compared with the traditional physical training programs they were significantly better[22]. However, physical readiness training followed the principles of sports training (Progressive Overload, Continuity, and Specificity), and it was designed to improve performance in combat tasks, increase physical fitness and prevent injuries[6].

Training periodization

Currently, periodization can be defined as the systematization of physical training interventions in a logical and integrative sequence that aims to maximize physiological adaptations to improve the physical performance of athletes. This systematization of interventions can relate to variables such as volume, intensity, density of the sessions, focus, technique, tactics, and frequency[20]. In the studies included in this review, it was possible to observe that of the 11 interventions found with non-traditional

training programs, only three applied non-periodized physical training protocols[9,23,24]. When compared, the periodized and non-periodized strength training did not obtain significant differences in performance gains in combat tasks[23]. Yet, the duration of the intervention (nine weeks) can be considered a limitation for this conclusion, as studies suggest that the periodization of training loads promotes greater adaptations related to physical performance than non-periodization[28].

The periodization of training for tactical athletes should be considered in the context in which they are embedded, and the choice of the appropriate model will depend on the athlete's work routine (training course, mission, or stationed with their military organization). The military personnel who participated in the included studies were in a military training routine, and the periodizations applied used linear and non-linear models. Thus, even if these periodization models were not directly compared, studies indicate that both models applied promote substantial improvements in the conditioning and performance of tactical athletes[26,29,30].

Intervention time, duration of the sessions, and training frequency

The intervention time of the training programs was 7 to 19 weeks and, as proposed in the methodology of this review, they all obtained positive results related to combat task performance. However, the studies with a greater duration (75-90 min) and frequency (3-5 days/week)[9,23,27] presented significant differences in the improvement in combat task performance when compared with traditional physical training. This denotes the importance of these variables in the planning of training for military personnel and in the obtainment of results favoring the proposed intervention.

Study limitations

This study presents limitations derived from the scarce quantity of publications regarding physical training interventions that evaluated combat task performance with samples composed exclusively of military personnel.

Practical applications

The present findings suggest that strength, functional, and physical readiness training programs improved the performance of military personnel in combat tasks. The use of periodization models in the systematization of the training variables obtained results favoring the proposed interventions. Although individualized training prescription should consider factors like baseline fitness level, the interventions found in this review seem to be better than traditional military physical training in improving military performance in combat tasks.

Conclusions

Based on the proposed objective and results obtained, it was possible to identify that studies involving different kinds of physical training methods improved the performance of military personnel in combat tasks. In this way, strength, functional, and physical readiness training programs seem to improve the performance of tactical athletes in combat tasks better than traditional military physical training. The use of periodization models obtained results favoring the long-term proposed interventions. In addition, the total training volume - intervention time and duration and frequency of sessions - appears to have a direct relationship with the difference in performance between the intervention and traditional physical training groups, corroborating with an increase in the efficiency of training programs that aim to improve physical readiness. Finally, although the generalization of the effects of the interventions may be compromised by the limited quantity of articles found, the specificity of this work activity means that the findings are relevant for improving the physical readiness and occupational health of tactical athletes.

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