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ROLE OF PHYSICAL FITNESS AND BODY COMPOSITION IN NAVAL CADETS: A NARRATIVE REVIEW

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ABSTRACT

Physical fitness is important to the general population, but for naval cadets, achieving a high level of physical fitness may be essential for success in their jobs. The purpose of this review was to summarize the current literature on physical fitness and body composition in naval cadets narratively and examine the effects of training programs on their physical fitness and body composition. The length of time that the personnel is on a ship cannot always be determined. For this reason, cadets must follow an exercise program to increase or maintain their physical condition during their voyages on a warship. This review revealed that endurance and strength training programs lasting 8 weeks to 12 months improved naval cadets' physical capacity, body composition, and BMI. In conclusion, this review provides practical suggestions for improving naval cadets' physical fitness and body.

Keywords: *naval cadets, physical fitness, body composition, body mass index*

INTRODUCTION

The Naval Service is a crucial part of the military cohort for numerous seafaring nations. Nations use several resources to ensure that naval services operate efficiently. Even though this operational efficiency includes major resources, such as warships, every naval cohort's functionality heavily relies on its personnel. Both financial and time resources are used to train personnel occupationally (Sargent et al., 2017). Hence, the physical well-being and fitness of Naval Service personnel are paramount.

First of all, obesity has become a global issue. Naval cadets are generally expected to be fit and to have a good body composition and body mass index (BMI). The World Health Organization (WHO) has introduced BMI guidelines (WHO, 2017), which provide valuable insights for the general populace. However, when examining naval service populations characterized by substantial muscularity, the applicability of these guidelines comes into question. In such scenarios, delving into alternative methodologies for a comprehensive body composition analysis becomes crucial.

Physical fitness is another important variable in naval cadets (Vantarakis et al., 2022). Physical fitness is essential to the general population, but for naval cadets, achieving a high level of physical fitness may be necessary to be successful in their jobs (Cuddy et al., 2011; Tingelstad et al., 2016; Warr et al., 2013). The length of time that the personnel is on a ship cannot always be determined. For this reason, cadets must follow an exercise program to increase or maintain their physical condition during their voyages on the warship. Physical fitness encompasses various components, and within an occupational context, its impact on job-related abilities gains significance. Specifically, tasks like onboard firefighting and casualty carry within the naval service hold occupational relevance (Sargent et al., 2017). Nevertheless, there is a requirement for further research to comprehensively evaluate the physiological stressors exerted on individuals engaged in specific naval service occupations.

Most research on military organizations often fails to distinguish between distinct military cohorts: the Navy, the Army, and the Air Force. However, conducting research delineating these cohorts could yield invaluable insights into their divergent characteristics and underscore the rationale for treating them as discrete entities. Such research has the potential to shed light on their unique dynamics and operational requirements. To our knowledge, no review study examined the importance of physical fitness and body composition of naval cadets. Based on the above, this review aimed to summarize narratively the current literature on naval cadets' physical fitness and body composition and examine the effects of training programs on their physical fitness and body composition.

METHODOLOGY

For this review, we searched the PubMed, SPORTDiscus, and MEDLINE databases to identify English-language sources using the following terms: "exercise training", "physical fitness", "aerobic training", "strength training", "circuit training", "body composition", "BMI", "training programs" AND "naval cadets". We also searched the bibliographies of the retrieved articles. We have included only English-language articles with no publication time limit.

BODY COMPOSITION AND BMI OF NAVAL CADETS

Obesity is an increasing global public health issue (WHO, 2017). The WHO defines overweight and obesity as abnormal or excessive fat accumulation that presents a risk to health (WHO, 2017). In many parts of the world, obesity and being overweight have become major health problems (Hansen et al., 2011; Nguyen, El-Serag, 2009; WHO, 2017). More than half of the adults in Greece are obese or overweight. According to WHO data from 2019, 37.9% of Greek adults are overweight, and 24.9% are obese. 44% of Greek men and 30.8% of Greek women are overweight, while both sexes show the same rates of obesity: one in four Greek men and one in four Greek women belong to this category (Georgakopoulos, 2022). In the naval cadets, several factors contribute to obesity, including an increasingly sedentary lifestyle, easy access to high quantities of food (Hansen et al., 2011), and the lack of control over the quality of food served (Oldenburg et al., 2013). Being overweight may reduce naval cadets' ability to perform daily duties. Furthermore, when naval cadets are situated aboard a ship, this concern escalates due to the heightened risk of restricted mobility during critical emergencies (Hoeyer, Hansen, 2005). A significant issue for naval cadets is that the time naval personnel spend on a ship during trips cannot always be determined. Additionally, the available space for sports on board is limited during free time. This is the main reason that contributes to their increased body weight.

BMI is one of the most commonly used methods for identifying adults who are overweight or obese, as it is easy to assess and incurs minimal costs (Nguyen, El-Serag, 2010; WHO, 2017). A lot of studies examined the BMI of naval cadets. For example, a study that investigated the Irish Naval Service found that, in the 18-35 age category, 58.4% were either overweight or obese; in the 36-50 age category, 78% were overweight or obese; and in the 51–60 age category, 95.6% were overweight or obese (Sargent et al., 2017). From the above study, we can see that, as age increases, so does the proportion of overweight or obese individuals. Similarly, a study on the U.S. Navy found that BMI increased with age in both genders. A study on U.S. service personnel over a 10-year period found that the number of individuals clinically diagnosed as overweight increased in all age groups (Armed Forces Health Surveillance Center, 2011).

A study by Bray et al. (2009) found that the percentage of overweight people in the under-twenty age group increased between 1995 and 2005 from 28% to 45% but decreased to 35% in 2008. There was an important finding in the study by Gregg and Jankosky (2012), which involved U.S. Navy males. It revealed that among those assigned to small submarines, 69% were overweight or obese. In the case of large submarines, 66% were overweight or obese, and the same applied to 63% of individuals assigned to aircraft carriers. The same study also found that the mean BMI for each group was similar to the general U.S. population. A study on the Irish Naval Service classified individuals into five different occupational categories to assess levels of being overweight, which included 1) fleet, 2) shore command, 3) officer command, 4) the naval college, and 5) naval headquarters. They found that the fleet had the highest number of obese and overweight cases, as 43% were overweight and 50% were obese (Sargent et al., 2017).

Moreover, many studies measured body fat. Two studies measured body fat and found that for Navy populations ashore aged between 31 and 33 years, body fat values ranged from 21.6% to 27.7% (Hodgdon. Beckett, 1984; Shake et al., 1993). However, the above values should be treated with caution, as the key message of these studies was that the dated circumference equations used for predicting body composition in Navy personnel classified incorrectly 6.8% and 18% of the recruits sampled as overweight and obese, respectively. Similar findings were also observed by Trent and Hurtado (1998). In their study, the first cohort of Navy personnel, followed for 8 years, showed an increase in body fat from 15% to 17.4%, while the second cohort, followed for 11 years, showed an increase from 16.4% to 17.3%. This trend was also reflected in BMI values, which increased from 25.1 to 26.5 in the 8-year timeframe and from 24.4 to 26.1 in the 11-year timeframe. Notably, this study presented the first longitudinal data encompassing a range of health behaviors and fitness measurements among Navy personnel. It also highlighted the growing effect of obesity on military populations, specifically on Navy recruits.

Also, two studies from Malaysia showed lower BMI values (21.6 kg/m^2 vs. 23.0 kg/m^2) but higher body fat values (16.8% vs. 10.2%) in Navy personnel compared to the Army branch (Razalee et al., 2010; Yusuf et al., 2012). In a separate large-scale study (Macera et al., 2011) involving U.S. Navy troops deployed in Iraq and Kuwait (n = 18,537), higher BMI values (26.3 kg/m^2) were recorded in the Army branch compared to U.S. Navy personnel stationed ashore (25.3 kg/m^2) (Graham et al., 2000). A similar pattern emerged from a study in Greece (n = 274) (Mazokopakis et al., 2004), where Navy officers deployed to warships exhibited a BMI increase of 5.5% in contrast to other Greek Navy staff stationed on land (23.5 kg/m^2 vs. 24.8 kg/m^2). Notably, comparisons undertaken by various research groups (Gasier et al., 2015; Gregg, Jankosky, 2012; Singh et al., 2011) among specialized employment groups, including submariners and crew members on aircraft carriers, have highlighted the influence of limited space and exercise availability on body composition and obesity rates. Analyzing data from these studies indicates an average 5% rise in BMI values among Navy recruits of comparable age deployed on small submarines compared to those on larger vessels. This suggests a discernible pattern in BMI values contingent on the residential context of the Navy group. Very important data were found by several studies which participated in Navy units of Special Operator Forces of varying ages. Trone et al. (2006) showed BMI values from U.S. Navy Sea Air And Land Teams (BMI: 23.9 kg/m^2) just below the overweight limit (25.0 kg/m^2) set by WHO but lower compared to the Navy units of Special Operator Forces (BMI: 26.0 kg/m^2).

However, the study by Jensen et al. (2016) reported an average BMI value of 27.1 kg/m^2 for Navy units of Special Operator Forces, which was above the overweight cut-off point but represented a higher mean age sample group (23.3 years vs. 37.0 years) compared to the study of Trone et al. (2006). Abt et al. (2016) and Oliver et al. (2015) presented body fat values for U.S. Navy Sea Air And Land Teams, which were higher (16.5% and 17.5% vs. 13.1%, respectively) in comparison to a younger age cohort in the U.S. Army (Schuna et al., 2013) (29 years and 31 years vs. 21 years respectively). In contrast, data from the study by Solberg et al. (2015) that participated Navy units of Special Operator Forces showed that body fat values (11.5%) were lower than the ones (15.7%) reported for the respective Norwegian Army Special Operator Forces units (Hoyt et al., 2006). It is worth mentioning that in the studies above, Navy personnel (Abt et al., 2016; Oliver et al., 2015; Solberg et al., 2015) were still within the acceptable range of body fat for U.S. Special Operator Forces units (below 18%) (Friedl, 2012).

EFFECTS OF TRAINING PROGRAMS ON BODY COMPOSITION AND BMI ON NAVAL CADETS

Only five studies have examined the effects of training programs on naval cadets' body composition and BMI (Table 1). The study by Vantarakis et al. (2022) examined the effects of training combining cardiovascular conditioning, circuit strength training, swimming, team sports, and obstacle courses on physical fitness and body composition during the basic military period of Greek Naval Cadets. They found a decrease in body mass by 2.5%, BMI by 2.6%, and body fat by 11.3%. Similarly, a study from the same group (Vantarakis et al., 2017) investigated the effect of 8-week strength training on navy-specific performance. After the training, there was a decrease in body mass and body fat by 1.7% and 13.0% respectively.

The study by Malavolti et al. (2008) measured body composition changes during 9 months of intense training with young men from a special faction of the Italian Navy. The training program included three phases: ground combat, sea combat, and amphibious combat. From the beginning until the subjects performed the ground combat phase, the training decreased their weight, fat-free mass, and body fat by 1.65 kg, 4.02 kg, and 1.7 kg, respectively. During the amphibious combat phase, body mass significantly increased by 2.13 kg, mainly because of an increase in fat-free mass by 3.93 kg, with a non-significant decrease in body fat. A similar trend was observed in the study of Abt et al. (2016), which measured the effectiveness of a strength training program during a training evolution of Naval Special Warfare Operators. After 12 weeks of a block periodized program, a loss in body mass and body fat by 0.70% and 8.2%, respectively, was observed among 85 Operators. The study by Solberg et al. (2015) examined the effects of a new training concept in the Norwegian Navy Special Operations Command. In this study, 22 operators completed a 6-month combined training with a linear protocol, followed by a 6-month combined training with a non-linear protocol. The results showed that the first protocol decreased body fat by 5% and increased body mass by 1%. The second protocol reduced body fat by 3% and increased body mass by 1%.

Moreover, many studies have investigated the effects of training programs on military subjects' body composition and BMI. For example, Salo et al. (2019) found that after 7 weeks of basic military training, body mass decreased significantly by 5.7% in the low fitness group, while in the good fitness group, it decreased by 1.5%, without a significant change in body fat. Santtila et al. (2008) examined the changes in body composition during an 8-week basic training combined with emphasized endurance or strength training among 72 conscripts. Both body mass and BMI remained unaltered in the endurance training group during the 8-week training period. Correspondingly, in the strength training group, all of the body composition variables of body mass (1.1%), BMI (1.1%), and body fat (16.3%) decreased. Margolis et al. (2012) investigated the effects of 10 weeks of military training on body composition. The results reported that body mass, BMI, and body fat decreased by 4.4%, 4.8%, and 13.9%, respectively, in male subjects. Further study has also shown a reduction in body mass (-1.7%) and in body fat (-20.3%) after 10 weeks of basic military training (circuit training, agility, swimming, endurance, and material handling) (Williams et al., 1999).

The study by Campos et al. (2017) examined the effects of 12 weeks of physical training on body composition in military recruits and found a reduction in body fat by 17.1% without altering BMI and body mass. Avila et al. (2013), after 13 weeks of military training, observed a reduction in body fat by 4.9% and no differences in BMI and were led to similar results to the studies of Campos et al. (2017), Williams et al. (2002) and Santtila et al. (2012). The study by Campos et al. (2017) showed a reduction in body fat by 17.1% and a minimal change in BMI. The study of Williams et al. (2002) aimed to evaluate the efficacy of a modified British Army basic training that included resistance training in improving material-handling performance, physical fitness, and body composition. The results showed that 11 weeks of training decreased body fat by 23.9% without significantly changing body mass. Santtila et al. (2012) found that after 8 weeks of basic military training, body fat decreased by 12.6%, but there was no significant difference in body mass. The same results (Campos et al., 2017; Santtila et al., 2012; Williams et al., 2002) were reported in an older study by Brock and Legg (1997). This study aimed to evaluate the influence of British army recruit training on the physical fitness and strength of female recruits. They found after 6 weeks of military training that the body fat decreased by 0.97%, without significant change in body mass.

PHYSICAL FITNESS OF NAVAL CADETS

Physical inactivity is a recognized risk factor for cardiovascular and other chronic diseases, including obesity, diabetes, hypertension, and cancer (ACSM, 2021). Recent health promotion guidelines for healthy adults recommend engaging in regular physical activity 3 to 5 times weekly (ACSM, 2021). Additionally, physical fitness plays a crucial role in naval cadets' training and performance. Aspiring naval personnel need to maintain a high level of physical fitness to meet the demands of their duties, which often include rigorous physical tasks, endurance challenges, and emergency response situations. Specialized training programs are designed to enhance their overall physical capabilities, ensuring their readiness for the demands of naval service.

The physical fitness requirements for naval cadets include cardiovascular endurance, muscular strength, agility, and flexibility. These attributes are vital not only for optimal performance during training exercises and drills but also for ensuring the safety and effectiveness of their duties while on ships or in maritime environments. Regular physical training and exercise regimes are integrated into naval cadet programs to help them build and maintain the necessary fitness levels. These training programs typically include running, swimming, strength training, circuit training, and other functional exercises that simulate real-world naval scenarios (Vantarakis et al., 2022).

By maintaining and improving their physical fitness, naval cadets are better prepared to handle the physical challenges they may encounter throughout their naval careers. Moreover, physical fitness contributes to their overall health and well-being, reducing the risks associated with a sedentary lifestyle and the potential for weight gain or obesity, which could hinder their performance during critical situations. Physical fitness is a fundamental component of the training and preparation of naval cadets, ensuring they are physically capable, mentally resilient, and ready to handle the physical demands of their roles within the naval forces. Furthermore, physical fitness can prevent injury or illness (Nindl et al., 2013). For example, a study in Norway showed that physical activity is associated with a low prevalence of musculoskeletal disorders (Morken et al., 2007), a common disorder in military settings (Litow & Krahl, 2007). However, improper implementation or a lack of guidance and understanding in training programs can also lead to injuries (Nindl et al., 2013).

A physical fitness test is typically conducted when individuals in the general seafaring population exhibit certain conditions. These conditions may include a high or significantly low body mass, severe reduction in muscle mass, musculoskeletal diseases, pain or movement limitations, post-injury or post-surgery conditions, lung diseases, cardiovascular disorders, blood diseases, or certain neurological conditions (Sargent et al., 2017). Research suggests that individuals with higher cardiorespiratory fitness levels tend to respond more calmly to stressful stimuli (Rimmele et al., 2007), indicating that employers in high-stress occupations might consider implementing a physical fitness test to assess coping abilities.

In many navy populations, all personnel must perform an annual mandatory physical fitness test (Sargent et al., 2017). Physical fitness is often measured by assessing aerobic capacity, strength, and endurance (Sargent et al., 2017). The physical testing conducted at the Hellenic Naval Academy generally consists of two parts. The first part involves a body composition assessment. In the second part, cadets are required to complete various tests, including a one-minute push-up test and a one-minute sit-up test to evaluate local muscular endurance, a 1 km run and a 100 m swimming test to assess cardiovascular endurance, and a 100 m run sprint for measuring anaerobic capacity. A similar testing protocol is also utilized in the Irish Naval Service, although there are alternatives to the 2.4 km run for evaluating cardiovascular endurance. Likewise, the U.S. Navy offers substitutes for the 1.5 km run to assess cardiovascular endurance, such as swimming, using an elliptical trainer, or a stationary bike (Sargent et al., 2017). Additionally, the British Navy provides alternatives like the Multi Stage fitness test and the Rockport walking test (used explicitly for older age groups or individuals with medical conditions preventing maximal exercise) (Sargent et al., 2017).

EFFECTS OF TRAINING PROGRAMS IN PHYSICAL FITNESS ON NAVAL CADETS

Only 6 studies have examined the effects of training programs in physical fitness in naval cadets (Table 1). These studies used mainly strength and aerobic training or circuit training. The study by Vantarakis et al.

(2022) examined the effects of training combining cardiovascular conditioning, circuit strength training, swimming, team sports, and obstacle courses on physical fitness and body composition during a 10-week basic military training period in Greek naval. The weekly training program included cardiovascular conditioning, circuit strength training, swimming, team sports, and obstacle courses. The measurements of the participants were on the number of sit-ups, push-ups, and pull-ups in 1 minute and on the 12-minute aerobic Cooper test (12-minute run) (Cooper, 1968). The results showed that the number of push-ups, sit-ups, and pull-ups in 1 minute significantly increased by 27.6%, 27.3%, and 20.8%, respectively. On the 12-minute run, the significant improvement exceeded 10.8%. A study by Vantarakis et al. (2017) determined the effects of an 8-week periodized strength protocol on the muscular strength and endurance performance of the Hellenic Naval Academy cadets. They observed increases in maximal strength, including increased bench press (1RM) by 14.5% and squat by 15.3%. Also, an improvement in 30-m sprint speed was found by 6.4%, push-up by 9.25%, and abdominal test performance by 17.2%. However, it is noteworthy that aerobic capacity, as measured by VO_2max, remained unaffected by the training intervention.

Abt et al. (2016) measured the effectiveness of two training programs when performed during a training evolution of operators. 85 operators participated in this study and performed in a 12-week block-periodized program. The first block was devoted to developing basic abilities, including cardiorespiratory endurance, muscular strength, and basic coordination. The second block focused on the development of power and strength endurance. According to the results, the VO_2max increased by 4.10%. Moreover, maximum pull-ups increased by 30.50%, the medicine ball throw by 2.82%, the standing broad jump by 2.94%, and the 1RM deadlift by 3.95%.

As referred previously, Solberg et al.'s (2015) study examined the effects of a new training concept in the Norwegian Navy Special Operations Command. Twenty-two operators participated in this study and completed a 6-month combined training linear protocol, followed by a 6-month combined training non-linear protocol. The linear protocol had an apparent effect on mobility (19%), abdominal strength (25%), upper body power (6%), lower body power (3%), strength (24%), agility (4%), aerobic capacity (2%). The non-linear protocol increased abdominal strength (15%), lower power body (4%), and anaerobic capacity (10%), whereas aerobic capacity (-3%) and upper power body (-2%) decreased.

Males et al. (2004) examined the effects of exercise training on the physical fitness of Croatian Naval cadets. All examinees were observed during the 2-month special navy training. The total sample was divided into experimental and control groups. Both groups participated in the physical training program. The main differences between the two training programs were a) frequency of the physical training (control group, 2 times/week; experimental group, 4 times/week) and b) duration and intensity of the endurance training (control group, 90 minutes of dominantly aerobic training; experimental group, 45 minutes of aerobic-anaerobic endurance training). The experimental group improved pull-ups by 53.15%, push-ups by 38.62%, sit-ups by 38.50%, squats by 21.0%, high jump by 2.77%, long jump by 3.36%, 60 m running by 6.37%, 100 m running by 5.82%, 200 m running by 8.06% and 1,500 m and 3,200 m running by 6.40% and 8.13% respectively. The control group improved performance in the squat by 5.89%, high jump by 0.60%, 60 m running by 0.64%, 200 m running by 1.13%, and 3,200 m running by 0.75%.

A previous study by Marcinik et al. (1985) examined the effects of three exercise training protocols (aerobic-circuit weight training performed at intensities of 40% or 60% of the determined 1RM, or aerobic-calisthenic training) on the physical fitness of Navy personnel over 10 weeks. The results showed that the aerobic-circuit weight training group at 40% 1RM improved bench press by 72.8%, leg press by 66.5%, and sit-ups by 8.1%. The aerobic-circuit weight training group at 60% 1RM improved bench press by 85.7%, leg press by 43.2%, and sit-ups by 9.2%. The aerobic-calisthenic training group improved bench press by 20.5%, leg press by 16.3%, and sit-ups by 6.9%.

Table 1. *Outcomes of training programs in physical fitness, body composition, and BMI of naval cadets and operators*

Study	N	Age (years)	Methods	Duration; Frequency	Results
Vantarakis et al., (2022)	185	18.4 ± 0.7	BMT (cardiovascular conditioning, circuit strength training, swimming, team sports and obstacle course)	10 weeks; 5 times/ week	BM ↓ 2.5%, BMI ↓ 2.6%, BF ↓ 11.3%, PU1 ↑ 27.6%, SU1 ↑ 27.3%, PullU1 ↑ 20.8%, 12-min run ↑ 10.8%
Abt et al., (2016)	85	29.4 ± 5.5	The first block was devoted to developing cardiorespiratory endurance, muscular strength, and basic coordination. The second block focused on the development of power and strength endurance	12 weeks; 6 times/ week	BM ↓ 0.7%, BF ↓ 8.2%, VO_2max ↑ 4.1% maximum pull-ups 30.5%, medicine ball throw ↑ 2.82%, standing broad jump ↑ 2.94%, 1RM deadlift ↑ 3.95%
Solberg et al., (2015)	22	28 ± 4	6-month combined training LP (hypertrophy bock, strength block, maximum strength block, mixed endurance block), followed by a 6-month combined training NLP (strength block, endurance block)	12 months; 5-6 times/ week	**LP:** BF ↓ 5%, BM ↑ 1%, FMS ↑ 19%, brutal-bench ↑ 25%, standing long jump ↑ 3%, medicine ball throw ↑ 6%, pull-ups ↑ 24%, agility ↑ 4%, VO_2max ↑ 2% **NLP:** BF ↓ 3%, BM ↑ 1%, brutal-bench 15 ↑, standing long jump ↑ 4%, anaerobic capacity ↑ 10%, VO_2max ↓ 3%, medicine ball throw ↓ 2%
Vantarakis et al., (2017)	31	**EG** = 20.3 ± 0.8 **CG** = 20.7 ± 1.0	**EG:** linear strength training program **CG:** -	8 weeks; 5 times/ week	**EG:** BM ↓ 2.5%, BF 11.3% ↓, BMI ↓ 2.6%, bench press ↑ 14.5%, squat ↑ 15.3%, 30-m sprint ↑ 6.4%, PU1 ↑ 9.25%, abdominal test performance ↑ 17.2%, VO_2max ↔ **CG:** No change was noted

Malavolti et al., (2008)	27	24.9 ± 3.4	The program pre-viewed three phases: ground combat, sea combat, and amphibi-ous combat	9 months	BM ↓ 1.65 kg, BF ↓ 1.70 kg, FFM ↓ 4.02 kg
Males et al. (2004)	307	22 (mean age)	**EG:** Elementary morning workout 5 times per week (aerobics 8 min, strength 7 min, flexibility 5 min) and physical training 4 times per week (anaerobic endurance 30 min, strength training or military skills training or obstacle courses or confidence courses 15 min, flexibility 15 min) **CG:** Elementary morning workout 5 times per week (aerobics 8 min, strength 7 min, flexibility 5 min) and physical training 2 times per week (aerobic endurance 45 min, strength training or military skills training or obstacle courses or confidence courses 30 min, flexibility 15 min)	8 weeks; 5 times/ week	**EG:** BM ↓ 0.44%, BF ↓ 4.56%, pull-ups ↑ 53.15%, push-ups ↑ 38.62%, sit-ups ↑ 38.50%, squat ↑ 21.0%, high jump ↑ 2.77%, long jump ↑ 3.36%, 60 m running ↓ 6.37%, 100 m running ↓ 5.82%, 200 m running ↓ 8.06%, 1,500 m running ↓ 6.40%, 3,200 m running ↓ 8.13% **CG:** BM ↓ 0.80%, BF ↓ 2.09%, pull-ups, push-ups↔, situps↔, squat ↑ 5.89%, high jump ↑ 0.60%, 60 m running ↓ 0.64%, 200 m running ↓ 1.13%, 1,500 running↔, 3,200 m running ↓ 0.75%
Marcinik et al., (1985)	**Study 1**: 43 **Study 2:** 87	**Study 1:** 32.1 (mean age) **Study 2:** 19.8 (mean age)	**Study 1**: Three exercise protocols of 40 min (aerobic circuit weight training at 40% of 1RM, aerobic circuit weight training at 60% 1RM, and aerobic calisthenic training) **Study 2:** flexibility, calisthenics, endurance run	10 weeks; 3 times/ week	**Study 1** **AWTG40%:** bench press ↑ 72.8%, leg press ↑ 66.5%, sit-ups ↑ 8.1%, flexibility ↔ **AWTG60%:** bench press ↑ 85.7%, leg press ↑ 43.2%, sit-ups ↑ 9.2%, flexibility ↔ **Study 2** bench press ↑ 20.5%, leg press ↑ 16.3%, sit-ups ↑ 6.9%, flexibility ↔

** Age is reported as Mean (SD). BMT = Basic Military Training; BM = Body Mass; BMI = Body Mass Index; BF = Body Fat; PU1 = Push-Ups in 1 minute; SU1 = Sit-Ups in 1 minute; PullU1 = Pull-Ups in 1 minute; 1RM = 1 Repetition Maximum; LP = Linear Protocol; NLP = Non-Linear Protocol; FMS = Functional Movement Screen; EG = Experimental group; CG = Control group; FFM = Fat-Free Mass; AWTG40%: Aerobic Circuit Weight Training at 40% of 1RM; AWTG60% = Aerobic Circuit Weight Training at 60% of 1RM; ↑ = statistically significant increase was noted; ↓ = statistically significant decrease was noted; ↔ = no change was noted.*

CONCLUSION

This study aimed to summarize the current literature on naval cadets' physical fitness and body composition narratively and examine the effects of training programs on their physical fitness and body composition.

To our knowledge, no review study has explored the importance of physical fitness of naval cadets. Physical fitness plays a crucial role in the lives of naval cadets, as achieving a high level of physical fitness and optimal body composition could be essential for their success in their roles. The duration of time naval personnel spend on ships can vary. Therefore, it becomes imperative for cadets on warships during their voyages to adhere to an exercise program that enhances or sustains their physical condition. This review reveals that endurance and strength training programs lasting 8 weeks to 12 months among naval cadets have decreased body mass and body fat by 0.44%-2.5% and 3.0%-11.3%, respectively, and conversely, observed improvements in their aerobic capacity and muscular strength range from 2.0%-10.8% and 2.8%-85.7%, respectively. This review study provides some practical suggestions to naval cadet coaches on improving the physical fitness and body composition of naval cadets.

LIMITATION

The main limitation of this study was that only a few studies examined the effects of training programs on naval cadets, and the information about the exercise training of naval cadets is limited. However, there are a lot of studies on military subjects.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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