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Marine Corps Physical Fitness

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FOREWORD

Marine Corps Reference Publication 7-20C.1, *Marine Corps Physical Fitness,* contains guidance for all Marines on how to develop and sustain physical fitness that prepares them for the rigorous physical responsibilities the Marine Corps requires. This publication provides a comprehensive approach to physical fitness, which broadens the scope and creates a more dynamic physical fitness mindset. This approach informs Marines at all levels how to apply physical fitness fundamentals and utilize resources to establish well-rounded skills.

This publication is not intended to mandate procedures or checklists but instead emphasizes how the Marine Corps values the physical fitness of Marines and their ability to be resilient. Physical fitness is one of four domains of Marine Corps Total Fitness and contributes to the holistic approach of maintaining the health and wellness of a United States Marine.

Reviewed and approved this date.

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CHAPTER 1.
THE PHYSICAL FITNESS DOMAIN

METHODOLOGY

Physical fitness is influenced by a constantly evolving world and affects the individual Marine as well as how Marines exist as a unit. Marines who maintain their physical fitness can physically accomplish all aspects of the mission while remaining resilient and lethal. This focuses on the domain of physical fitness and having knowledge needed to contribute to a holistic approach to health and wellness. Optimal physical fitness reflects the Marine Corps values by honoring the body and its fitness, the courage to identify shortcomings, and the commitment to improvement.

Marine Corps Total Fitness (MCTF) is a cohesive mix the four fitness domains (physical, mental, spiritual, and social) that prepare Marines to be resilient and achieve mission success. The physical fitness domain serves a significant role that requires each Marine to be accountable, committed, and organized. Just as Marines learn their skills through individual military occupational specialty (MOS) schools and then hone their skills and knowledge through experience, they must apply dedication to achieving physical fitness.

Marine Corps Total Fitness promotes a holistic view of health, wellness, and performance that focuses on the four fitness domains. Ensuring holistic well-being boosts a Marine's morale, cohesiveness, and resiliency. Each domain must continuously be evaluated and addressed to be optimally effective because they directly influence each other. This publication provides Marines the resources for further guidance on mental, spiritual, and social domains, while primarily addressing the key points of physical fitness.

The Warfighter and Physical Fitness

Resiliency is one of the most important qualities acquired through physical fitness. When Marines are faced with challenges in and out of combat, they can meet those challenges through internal and external support and strength honed by their physical fitness training. For many Marines, their first physical challenge is during recruit and candidate training. The Crucible or the first time running the endurance course could be a Marine's first physically-demanding challenge, but it will not be the last. Internal support for physical fitness comes from a foundation of consistent physical fitness programs and practice. External support comes from uniformed and civilian personnel, such as a force fitness instructor (FFI), athletic trainers, strength coaches, dietitians, and performance psychologists. These personnel help Marines develop and maintain physical fitness.

Physical demands placed on Marines to achieve operational goals are similar to demands placed on elite athletes. The most successful athletes understand the body's anatomy and how it functions. This knowledge helps elite athletes train efficiently and effectively. For example, to perform a successful deadlift exercise, weightlifters understand most of the force is generated by

the hamstrings and gluteus muscles. They understand they must develop their core strength and stability to protect their back, and control and direct force generation. Weightlifters must develop mobility and proper mechanics to optimize performance and decrease the risk of injury. A task that requires similar actions to a deadlift can be as simple as picking up a water jug from the ground and lifting it onto a vehicle. These types of everyday tasks can cause wear and tear to the body if consistently performed incorrectly.

WHAT IS THE PHYSICAL FITNESS DOMAIN?

Physical fitness is defined as the ability to physically accomplish all aspects of operational tasks while remaining mission-capable and avoiding injury. It is having the strength, endurance, coordination, and capacity necessary to succeed in any environment. The physical fitness domain's main components include health and wellness, physical training, nutrition, injury prevention, brain health, rest, and recovery to maximize performance. Resilient Marines can better deal with physical discomfort from training when they understand, it helps Marines improve endurance, performance, awareness of limitations, and the ability to challenge those current limits. They know the difference between discomfort and injury and seek medical treatment when necessary to receive proper care and avoid limited duty (LIMDU).

ANATOMY AND PHYSIOLOGY

Marines need to understand the basics of anatomy and physiology with regard to human movement. The four systems that directly affect physical fitness include the respiratory, cardiovascular, nervous, and musculoskeletal systems. When one or more systems in the body malfunction, injury and illness can occur. Understanding how each system functions helps a Marine prevent injury or illness. Having an injury or illness can lead to LIMDU or compromise performance.

Respiratory System

The respiratory system includes the upper airway, lower airway, lungs, intercostal muscles, and the diaphragm. Breathing, or the exchange of oxygen and carbon dioxide, is important to the cardiovascular system and muscular endurance. Muscles need oxygen to function, so without enough oxygen performance decreases.

Breathing. Breathing is an involuntary function regulated by the nervous system. During physical activity, there is an increase in how often (breathing rate) and how hard (intensity) one must breathe to increase the amount of oxygen to the muscles. Controlling one's breathing during physical activity helps delay fatigue and increase focus on the task. This is particularly important under high-pressure situations. Marines who can control their breathing are more likely to have a positive influence on their actions and focus, which enables longer periods of physical activity.

During physical activity, the body needs more oxygen for muscle function, so it involuntarily increases its breathing rate to help increase oxygen. The breathing rate is determined by the number of breaths taken per minute. During physical activity, muscles naturally release energy byproducts created in the form of carbon dioxide and lactate. The carbon dioxide and lactate go

into the blood and signal the body to increase its breathing rate, which becomes higher during intense exercise. Increasing cardiovascular endurance (see "Cardiorespiratory Fitness" in this chapter) is important for the body to better tolerate the carbon dioxide and lactate effects.

VO2 Max and Lactate Threshold. As a Marine's level of fitness improves, the body becomes more efficient with using oxygen for energy during physical activity. This efficiency allows the body to use less oxygen to perform the same amount of work. This is called VO2 max. Highly fit Marines will have higher levels of VO2 max. A higher level of VO2 max typically accompanies a higher lactate threshold (see Figure 1-1).The lactate threshold is the rate of lactate accumulation (a by-product created in muscles during physical activity) above resting levels. Those with higher running speeds at lactate threshold have improved their muscle's functionality at low outputs, allowing them to delay the accumulation of lactate in the blood. Both VO2 max and lactate thresholds are reliable measurements of aerobic endurance. Increasing VO2max allows a Marine to do more work while meeting the increased oxygen demand, thus delaying fatigue. Increasing lactate threshold allows the Marine to delay fatigue at the same output of energy (e.g., maintain the same hiking speed as another Marine carrying the same load) due to increased aerobic conditioning of the muscles.

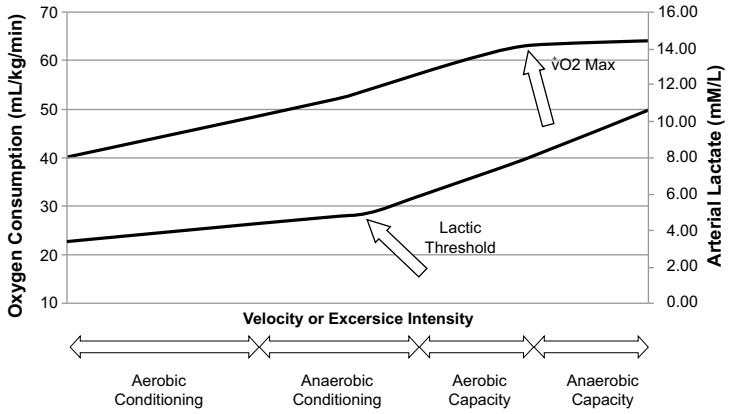

Figure 1-1. VO2 Max and Lactate Threshold.

Cardiovascular System

The cardiovascular system (see Figure 1-2) is responsible for maintaining the body's blood supply. Blood moves oxygen to the muscles during physical activity. A good blood supply is also essential for recovery from exercise. It brings oxygen and nutrients to the tissues so they can remodel, grow, and replenish.

The cardiovascular system consists of the following three main parts:

- The heart pumps blood throughout the body and is physically connected to the lungs.
- The blood has several components that include red and white cells, and plasma.
- The blood vessels are the blood's transportation system to and from the heart via arteries and veins.

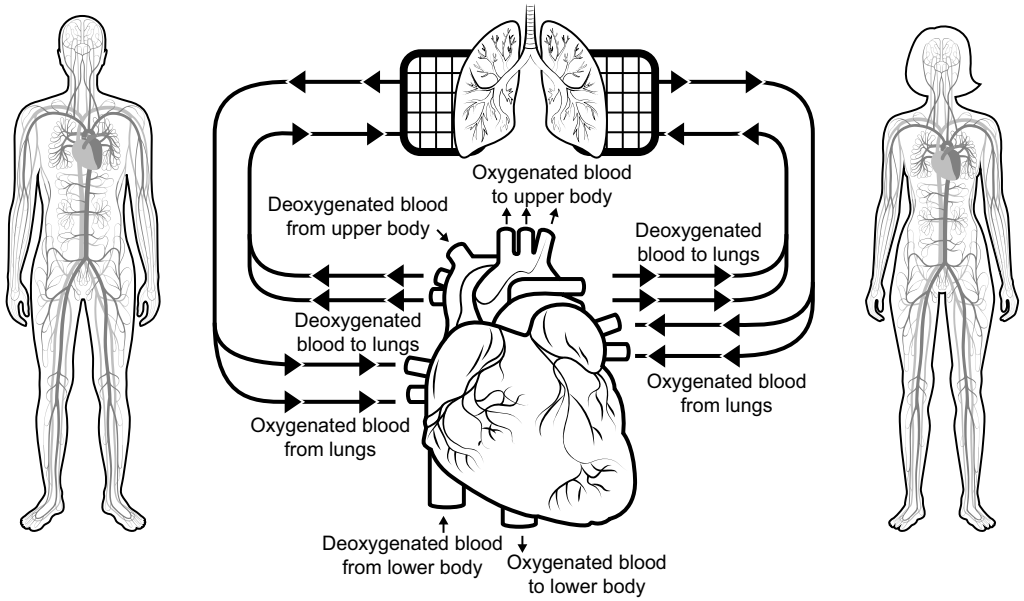

Figure 1-2. Cardiovascular System Transportation Pathways.

Physical training is vital to preparing the cardiovascular system, so it can provide and sustain oxygen delivery. Table 1-1 describes the three main functions of the cardiovascular system.

Table 1-1. Three Main Functions of the Cardiovascular System.

Transportation	Regulation	Protection
Delivers oxygen, healing agents, and nutrients.	Maintains the body's potential of hydrogen (pH) balance.	Forms blood clots to stop bleeding.
Removes carbon dioxide, heat, and cell waste products.	Maintains the body's temperature.	Carries antibodies to fight infection.

Heart Rate and Blood Pressure. Heart rate refers to the number of times a heart beats per minute. When exercising, maximum heart rate is often used as a guide to target different exercise intensity levels. Blood pressure is the resistance of blood flow due to blood thickness and vessel size and thickness. Heart rate and blood pressure increase during exercise to meet increased oxygen demands. Refer to Chapter 2 for more information on heart rate and blood pressure.

Nervous System

The nervous system communicates signals from the brain to the rest of the body and vice versa. This communication allows muscles to perform and act on different sensations, such as recognizing how heavy an object is and producing the force needed to lift it.

The nervous system is a control center for most bodily functions, and it can be broken down into the following sub-systems, with each subsystem having its own unique function:

- *Central Nervous System (CNS)* consists of the brain and spinal cord and controls the body's functions.
- *Peripheral Nervous System (PNS)* consists of nerves that stem from the spinal cord to the body; it collects sensory information and sends motor signals.

- *Autonomic Nervous System (ANS)*:
  - Sympathetic Nervous System is responsible for the "fight or flight" response.
  - Parasympathetic Nervous System is responsible for "rest and digest" functions.

Understanding the nervous system is important because it can be trained and regulated through physical fitness. The more often a Marine conducts physical training, particularly in relevant environments and scenarios, the more body control that Marine has in unfamiliar situations. During field operations, a Marine who is sleep-deprived stays in the "fight or flight" response. However, a trained Marine can minimize the intensity of this response and better perform the task at hand by balancing the sympathetic and parasympathetic nervous systems to allow for optimal performance (sympathetic) and fast recovery (parasympathetic).

The nervous system has three main functions that physical training affects (see Figure 1-3):

- *Sensory function* includes senses of touch and feel (for example, wet, cold, smooth).
- *Integrative function* stores sensory information for later use and processes for action.
- *Motor function* controls body (i.e., muscle) movements (voluntary and involuntary).

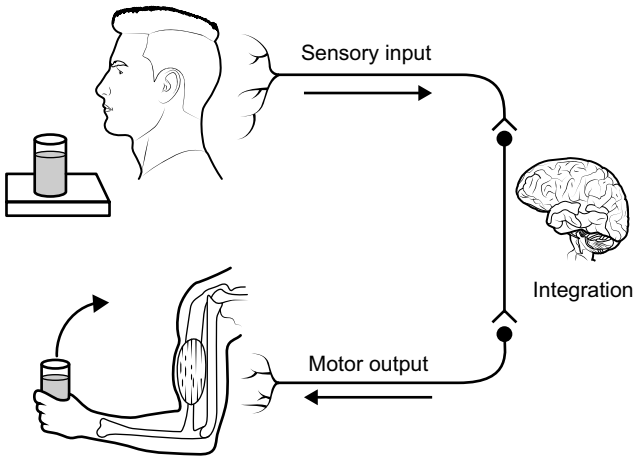

Figure 1-3. Three Functions of the Nervous System in Action.

While performing an element of the combat fitness test (CFT), such as throwing a grenade in the maneuver-under-fire event, the nervous system's sensory function gives feedback. For example, if the grenade is wet, this can signal that a grip adjustment should be made so it does not slip out of the hand too early. The integrative system assists by providing feedback from previous experiences. Marines conducting high or low crawls during a post-rain CFT can draw on their previous experience with wet and slick terrain and adjust to the current task. Motor systems help muscles perform the required work. For example, during the buddy carry, Marines' muscles must adjust to their buddy's weight and size to succeed in completing the task.

Musculoskeletal System

The musculoskeletal system is the framework of the body. Every person has the same basic structure, but size and shape varies based on genetic factors. Without the musculoskeletal system, it is impossible to perform physical activity. The two main components in this system are—the skeletal system (bone), and myofascial system (muscle).

Skeletal System Anatomy. Bones are uniquely designed and can strengthen with training and exercise since they can hold up against intense physical tasks. Injury can occur when physical stress is greater than that which the bone can withstand. The average skeleton has 206 bones and consists of five different bone types: flat, short, long, irregular, and sesamoid. Figure 1-4 depicts the skeletal system. The skeleton is made so a body can perform essential tasks as simple as marching, holding a rifle, or navigating through extreme conditions and obstacles.

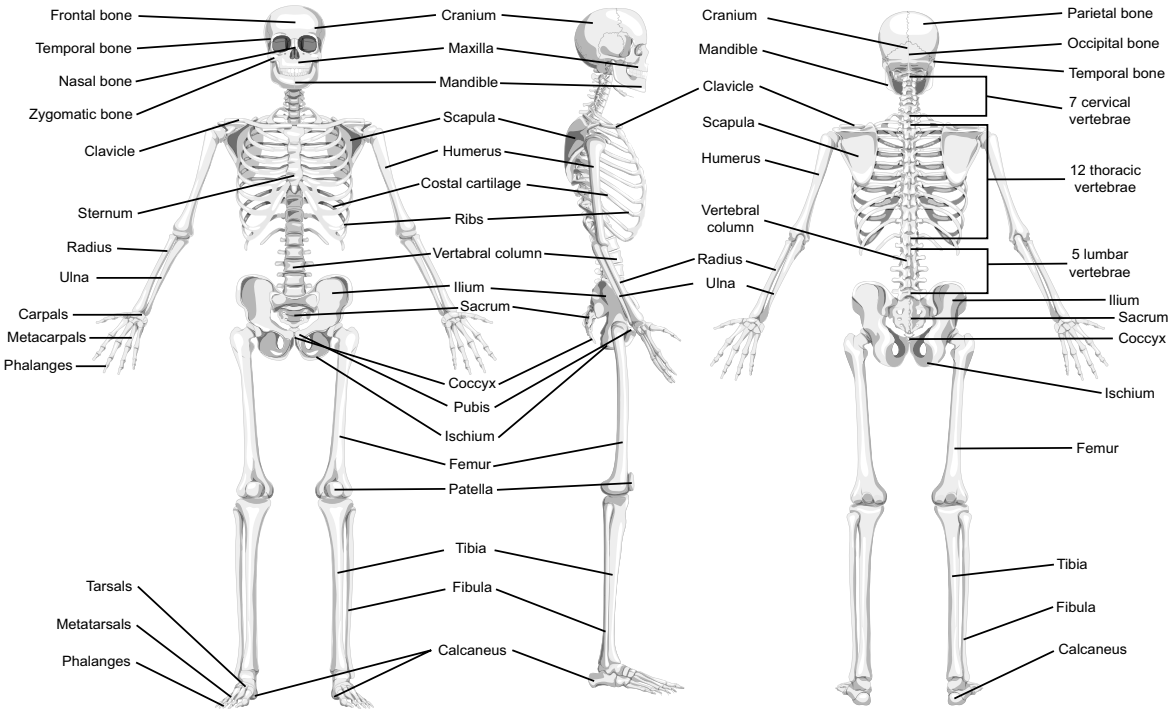

Figure 1-4. The Skeletal System.

Besides withstanding physical stress, the skeletal system—

- Creates movement at the joints.
- Protects vital organs.
- Stores minerals to help prevent injury and aid energy production.
- Produces blood cells in the bone marrow to help create energy and promote healing.

Myofascial System. The myofascial system includes the muscle, tendon, and the surrounding fascia. There are more than 600 muscles in the body, and each one is a collection of individual muscle fibers. The three muscle types are as follows:

- *Skeletal*: voluntary muscles that create movement and support the skeleton; these muscles are at the highest risk for injury during physical training and operational tasks.
- *Smooth*: involuntary muscles that line organs (bladder, stomach, intestines, etc.) to perform life-sustaining functions; these muscles can become injured by blunt force trauma.
- *Cardiac*: involuntary muscles that help the heart contract and pump blood; these muscles can be injured through blunt force trauma or unknown heart conditions.

Skeletal muscles attach to bones by tendons and are composed of two main types of fibers (see Figure 1-5). Each has a different function, but they work together to sustain physical effort. A muscle contraction is called a twitch and can take place either quickly or slowly, as defined by whether they produce endurance or bursts of power (consider the energy needed by a long-distance runner verses a sprinter). The two types of twitch fibers are—

- Slow twitch (type I) fibers create a slow muscle contraction, withstand fatigue, and are slow to relax (e.g., marathon runners may have high levels of type I fibers).
- Fast twitch (type II) fibers develop force and relax quickly sprinters may have high levels of type II fibers).

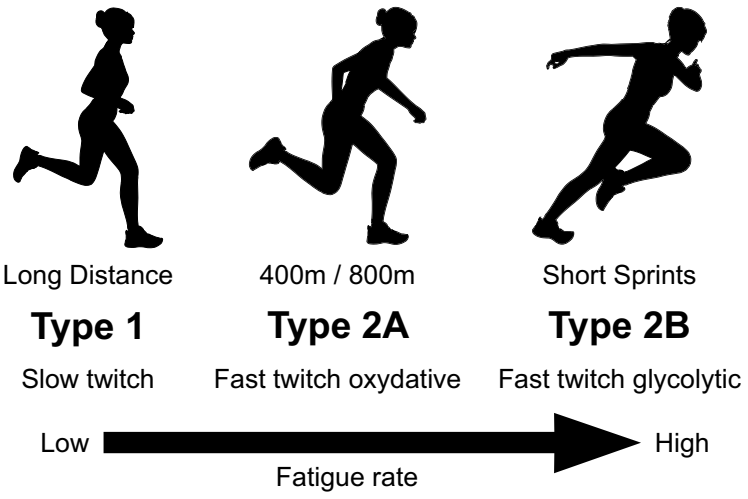

Figure 1-5. Muscle Fiber Types and Exercise Examples.

Connective tissue surrounds and protects muscles and bones. It can be injured separately from the muscles and bones but is most often injured in conjunction. There are two main types of connective tissue:

- *Fascia*: a sheet of tough tissue under the skin that surrounds muscles and organs. It can get "stuck" on itself (like saran wrap) and decrease movement and function.
- *Cartilage*: strong connective tissue that supports, absorbs shock, and facilitates smooth movement at joints (i.e., knee meniscus and shoulder or hip labrum) and is a common injury in individuals who participate in high-intensity physical activity.

Each myofascial system component works together to serve three primary functions, which are—

- *Movement*: coordinates large muscle movements (running and walking) and fine muscle movements (writing and shooting).
- *Stabilization*: resists physical stress and maintains body posture for efficient and powerful movement.
- *Heat Production*: muscle contractions produce heat from the energy they create, which can affect body temperature and performance.

Skeletal muscle contractions occur when the brain signals the muscle to create movement. When they contract, the tendon that attaches the muscle to the bone creates the desired force and movement. All muscle contractions should be trained in a physical fitness program because each is required in any physical activity. There are three muscle contraction types (see Figure 1-6):

- *Isometric*: the muscle contracts without lengthening, and force is produced without movement. (e.g., carrying a pack on a hike or holding a rifle steady).
- *Concentric*: the muscle contracts and shortens, and force is produced with movement (e.g., bicep curls or raising the body during a pull-up).
- *Eccentric*: the muscle contracts as it lengthens, and force is produced for control and deceleration. (e.g., walking or jogging down a steep hill, or lowering the body during a pull-up).

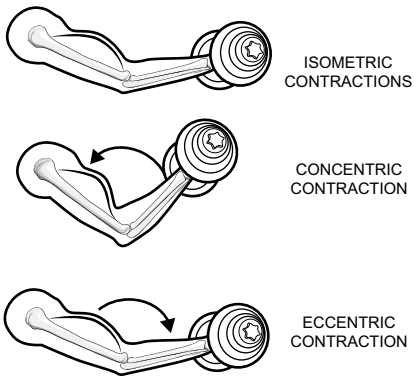

Figure 1-6. Muscle Contraction Types.

Anatomical Positions

The anatomical position provides a universal reference for directions of the human body. It provides the clarity, consistency, and accuracy necessary to fitness instruction and execution. Anatomical position is the body in an upright position, legs together, knees straight, toes pointing forward, and arms by the side with the palms facing forward. Two more specific positions Marines need to understand and use in physical tasks are—

- *Supine*: lying down, face up.
- *Prone*: lying down, face down.

Range of Motion

Range of motion (ROM) is how much a joint naturally moves. Each joint has different capabilities depending on its type and other variables, such as an injury or the flexibility of surrounding muscles. Table 1-2 describes how joints execute their respective range of motion.

Table 1-2. Range of Motion Definitions.

Range of Motion Name	Definition
Flexion	Bending
Extension	Straightening
Abduction	Moving away from the middle of the body
Adduction	Moving toward the mid-line of the body
Rotation	Twisting
Circumduction (shoulder and hip)	Moving in a circular motion
Inversion (ankle)	Turning the foot in
Eversion (ankle)	Turning the foot out
Dorsiflexion (ankle)	Pointing the foot up
Plantar flexion (ankle)	Pointing the foot down
Pronation (foot)	Rolling in
Supination (foot)	Rolling out
Pronation (hand)	Turning the palm downwards
Supination (hand)	Turning the palm upwards
Elevation (jaw and shoulder blade)	Moving up
Depression (jaw and shoulder blade)	Moving down
Retraction (shoulder blade)	Pinching in and together
Protraction (shoulder blade)	Pushing out and away

Understanding ROM is important so it can be incorporated into a physical training program. For example, shoulder circumduction and rotation is used when reaching for a weapon behind one's back. Movements required to perform tasks such as these rarely happen one at a time, but are successive tasks requiring multiple, simultaneous movements. In the previous example, other motions such as pronation, supination, and movements of the shoulder blade all make reaching for a weapon quick and efficient.

Many common injuries Marines experience happen when a joint moves past its normal ROM. For example, a lateral ankle sprain occurs when there is excess or forced inversion (e.g., stepping on uneven terrain). Knowing what ROM caused an ankle sprain helps because Marines can avoid replicating the motion, which would exacerbate the damage during their recovery, and then improve strength through that motion to help prevent injury reoccurrence.

PHYSICAL FITNESS FUNDAMENTALS

A person's physical fitness level is determined by their ability to perform activities that require endurance, strength, and flexibility. Warfighting requires a balanced approach to physical fitness and an understanding of its components and fundamental concepts. Four main components of physical fitness are needed for a balanced program: cardiorespiratory fitness, muscular conditioning, flexibility and mobility, and balance and proprioception. All four components pertain to the health and fitness of the heart, lungs, and musculoskeletal system.

By training in each fundamental physical fitness component, a Marine prepares to handle any task and adapt to sudden changes. Most importantly, following a progressive, balanced physical fitness program helps to prevent injuries. Part of a logical progression that leads to operational readiness would be to build up hike mileage over time. This approach has many benefits, such as getting used to various environmental factors (weather, terrain, etc.), increasing muscular strength to help avoid strains, and increasing aerobic endurance to fight fatigue.

Cardiorespiratory Fitness

Cardiorespiratory fitness is training the heart and lungs to improve oxygen delivery to working muscles. High cardiorespiratory fitness levels help the heart pump more blood, increase how much air the lungs can hold, and strengthen muscles that help with breathing. Cardiorespiratory fitness consists of aerobic and anaerobic conditioning:

- *Aerobic* is the ability to exercise large muscle groups for long durations with lower intensity.
- *Anaerobic* is the ability to perform short but powerful amounts of exercise at a higher intensity.

Optimal cardiorespiratory fitness allows Marines to conduct tasks requiring a high tolerance against fatigue and discomfort. It helps decrease the occurrence of being out of breath and increase one's ability to perform higher-intensity movements at increasing frequency.

Aerobic Training. Aerobic training activities maintain a consistent pace (intensity) for a specific time (duration), such as hiking or endurance activities. Aerobic training primarily requires slow-twitch muscle fibers to sustain activity for longer durations. It is recommended that aerobic training sessions initially last at least ten minutes and up to 30 minutes, increasing or decreasing intensity based on the duration. Marines with higher aerobic fitness levels benefit from sessions that are at least 30 minutes to an hour. These time and intensity training measures help prevent overtraining and injuries. Marines should progress from low-, to moderate-, and then high-intensity aerobic training to prepare for the physical demands of combat. Low-, moderate-, and high-intensity aerobic training each have a beneficial place in a physical training program (read "Key Components of Physical Fitness" in this chapter for guidance on a balance-training program).

Moderate- and High-Intensity Aerobic Training. Moderate-intensity aerobic training is a cardio (steady state) activity that accelerates the heart rate but remains at a comfortable level. A Marine should still be able to speak a few sentences during this type of intensity. This intensity should be performed at least five days a week, for 30 minutes a day (150 minutes a week).

High-intensity aerobic training consist of activities such as running at or above a three-mile pace and includes competitive sporting events. It substantially accelerates the heart rate and produces rapid breathing. A Marine should not be able to comfortably speak in full sentences during this type of intensity. This intensity should be performed at least three days a week for 20 minutes a day (ranging from 60–75 minutes a week).

These are the minimum recommendations for a moderate and high-intensity aerobic training. Marines with a higher aerobic fitness level need to increase the amount of aerobic training while using the key concepts of physical fitness as guidance. Installation and unit resources (e.g., FFIs, Sports Medicine and Injury Prevention [SMIP] specialists and Marine Corps Community Service [MCCS]) provide professional guidance.

Anaerobic Training. Anaerobic training primarily uses fast-twitch muscle fibers to help produce powerful movements. Less oxygen is required to create energy, meaning it contributes less to cardiorespiratory endurance than aerobic training. Training intervals last from 30 seconds to three minutes and use short bouts of effort that demonstrate power.

Anaerobic fitness is important for tasks such as repetitively lifting heavy objects, as when loading supplies onto a vehicle or lifting artillery ammunition. Although important for everyday job responsibilities, this type of fitness is important for mission-essential tasks in high-pressure situations. The less fatigue Marines experience, the more resilient they are.

Muscular Conditioning

Types of muscular conditioning include the following:

- *Resistance* (*strength*) *training*: increases and maintains muscular strength, power, and endurance.
- *Strength*: maximum force a muscle group can produce.
- *Power*: a combination of muscle strength and speed that produces quick movement.
- *Endurance*: the ability of a muscle group to perform repetitive movements for a specific time.

Muscular conditioning should be conducted on two or more nonconsecutive days each week. Each session should include eight to ten exercises using major muscle groups. The weight (intensity) used should create muscle fatigue after eight to 12 repetitions of each exercise. A minimum of two sets are effective in improving muscular strength, power, and endurance.

Most tasks require all three muscle-conditioning components. For example, during the CFT when Marines are required to lift and carry a buddy across the course, strength and power are needed to lift, and endurance is needed to succeed in covering the required distance. The Marine then needs to be ready for the next task in the CFT.

Muscle Characteristics and Physical Activity. Muscle characteristics that can affect one's physical abilities include temperature, fatigue, and disuse and immobilization.

Temperature. Before starting physical activity, muscle tissue is at its resting temperature. This can be described as "cold muscles." Muscles can become "warmed up" and prepared for physical activity by increasing blood flow. Conducting physical tasks using cold muscles increases the risk of injury to the muscle or other body parts due to dysfunction. This can be compared to a rubber

band, which, at a warmer temperature can stretch more easily than a rubber band that has been kept in a freezer. Experiencing the same force, the cold rubber band is more likely to break than the warm rubber band.

Fatigue. If a muscle has adequate oxygen supply and nutrients that can be broken down to adenosine triphosphate (ATP), it can sustain itself. Adenosine triphosphate provides the muscle energy and must be able to keep up with the intensity of exercise because, if ATP production cannot keep up with the energy demands, muscle responses can weaken. This decreased response is fatigue, which can be identified by—

- Lack of movement and coordination.
- Decreasing quality of skills.
- Decreasing accuracy, control, and speed of muscle contraction.

Marines maintain an adequate oxygen supply through consistently training and progressing with cardiorespiratory, endurance, and muscular conditioning.

Disuse and Immobilization. Muscles have a "use it or lose it" quality. If the muscle is not used, loss of muscle endurance, strength, or size (atrophy) can occur. On the other hand, when a muscle is regularly used, positive effects such as an increase in muscle strength and size (hypertrophy) occur. It is important for Marines to understand their job responsibilities to tailor a physical fitness program that will prepare them for physical challenges they might face. For example, overhead strengthening activities such as an ammo can lift can help a Marine prepare for lifting equipment onto a vehicle.

Flexibility and Mobility

Flexibility and mobility are the combination of elasticity, joint range of motion, and control of the muscles:

- *Flexibility*: the ability to move a joint through its full range of motion.
- *Mobility*: the ability of muscle contractions to move a joint through its range of motion.

Flexibility requires elasticity, or the ability of an object to stretch and return to its original state. The less elasticity there is, the less flexibility there is. When a muscle or tendon lacks flexibility, it can also decrease a joint's mobility. Mobility is different from flexibility because it is the joint's ROM, and how far it can move in that direction. Flexibility is only affected if the muscle can stretch, whereas movement is affected by flexibility, joint structure, external barriers (e.g., uniform, gear), and internal factors (e.g., scar tissue, bone abnormalities, swelling).

Some joints are more mobile while others are more stable. For example, the shoulder is a highly mobile joint capable of many ROMs (circumduction, rotation, flexion, extension, abduction, adduction, and all scapular ROMs); compared to the knee joint which has only two ROMs (flexion and extension). The shoulder is built for more versatile movements. Understanding this and training each joint to its specific motions helps prepare it for sudden and unanticipated movements. It also decreases the likelihood of overuse injuries from repetitive motions lacking flexibility and mobility.

Balance and Proprioception

Balance and proprioception are understanding how the body moves and supports itself during physical activity. This requires controlling the speed of movement and being aware of how the body moves in the surrounding space. Training balance and proprioception requires an understanding of the sensory, integrative, and motor functions of the nervous system:

- *Balance*: the ability to distribute weight as to remain in a desired position; critical for one-sided (unilateral) movements and activity on uneven terrain.
- *Proprioception*: the awareness and control of the body in the surrounding space; critical for skills and activities that require accuracy and coordination.

When firing a rifle, a Marine must demonstrate balance and proprioception. Balance must be maintained in the firing position whether a person is prone, kneeling, or standing. Proprioception is used to move and hold the rifle in a position that results in an accurate shot. Moving over unfamiliar terrain also requires balance and proprioception. When properly trained, the body can better navigate unfamiliar settings, allowing a Marine's focus to remain on the task.

Being an infantry Marine has multiple physical attributes that are reflected in each fundamental concept of physical fitness. Cardiorespiratory fitness is needed for tactical movements over a distance. Muscular endurance is needed to carry weapons and gear for long durations. Flexibility and mobility are needed to reach ammunition that may be located behind the back. Proprioception is needed to know where the rifle should be positioned for an accurate shot. These primary components pave a successful path to maintaining physical fitness.

Additional Program Components

Each component of physical fitness has an important role in preventing injuries and attaining high levels of physical fitness. By understanding the foundations of fitness, leaders can enhance each domain of a Marine's physical fitness by applying the best available scientific evidence. These additional aspects of fitness are necessary to create a well-rounded physical fitness program.

Dynamic Warm-Up and Cool Down. A dynamic warm-up and a cool-down routine should be included in any physical training. Dynamic warm-up routines prepare the body for safe and effective performance. They prepare the body to respond to the physical demands it is about to be asked to perform by increasing the muscle temperature and priming the nervous system's motor functions. Going straight into a moderate or high-intensity activity without physical preparation increases the risk of injury.

The purpose of the cool down is to gradually return the body to its resting state and to prepare it for the next training session. Gradually decreasing intensity helps muscles recover from the stress they receive during activity. This stress is necessary to make muscular improvements (e.g., gain strength, power, endurance) through recovery. It also gives time for the heart rate and breathing to safely return to a normal state. The better physical shape the Marine is in, the more quickly the heart rate and breathing can return to normal.

Speed and Agility Development. Speed and agility development contribute significantly to one's physical fitness because they make efficient and safe workouts possible. It is important establish a foundation or baseline before progressing one's speed and agility. Speed is the amount of time it

takes to perform a task, and agility is the accuracy of the movements. The CFT is a great example of the use of speed and agility. Because the CFT is a timed event, maximizing speed ensures the course is completed in the required time, but agility is needed to make sure it is completed accurately. For example, Marines conducting the maneuver-under-fire task require speed during the initial 25-yard sprint, but also agility when they need to slow down and change directions to get ready to perform the high crawl.

Three methods to improve speed and agility are—

- *Primary Method*: Executing sound movement and techniques in a specific task. Performing at submaximal speeds to focus on form and technique.
- *Secondary Method*: Using sprint training to provide resistance without sacrificing form and technique:
  - Sprint resistance: gravity-resisted running (e.g., incline sprints) or inducing an overload effect (i.e., harness, parachute, sled, weighted vest).
  - Sprint assistance: gravity-assisted running (e.g., sprinting downhill on a shallow slope), high-speed towing (i.e., harness and stretch cord).
- *Tertiary Method*: Working to achieve a pre-determined goal, or a target pace in training or competition.

Core Strength and Stability. The core is made of the bones, muscles, and connective tissue (e.g., ligaments, cartilage) in the trunk and torso region, which includes the ribs, spine, pelvis, and shoulders. Having core strength and stability is critical to success in every physical fitness program. Power for all movement starts with the core, and it creates smooth, efficient, and better coordination. The two main core-conditioning advantages include:

- *Stabilization Support*: maintains the spine's natural curve, allowing the core to work and stabilize the body.
- *Core Strength*: develops through various exercises that combine stabilization (e.g., planks), and dynamic functions (e.g., alternating hand and leg raises while on hands and knees).

Neuromotor Training. Neuromotor training involves training nerve impulses to the muscles to maintain and improve body control. It includes motor skill activities that develop and improve balance, agility, coordination, gait, and proprioception. This type of training should be conducted two to three days a week for at least 20 to 30 minutes at a time (40 to 60 minutes per week) to improve integrative nervous system functions. For Marines increasing the level of difficulty by incorporating new challenges into their exercises, neuromotor training can be incorporated with resistance training by adjusting exercise positions (e.g., half-kneeling, kneeling, standing, split stand, single leg).

Foundational Movements. Seven movements are considered essential and are the basis for almost all movements. Performing these motions using good form helps avoid injury and fatigue. Incorporating these movements into a physical fitness program is key to training the integrative and motor functions of the nervous system.

The seven movements are—

- *Push*: using the upper body to move objects away from the body, or the body away from objects (e.g., pushup or sled-push).
- *Pull*: using the upper body to bring objects closer to the body, or the body closer to an object (e.g., rowing or a pull-up).
- *Squat*: bending at the hips and knees to bring the body downward while the chest remains upright, the spine in alignment, and the knees in line with the ankles.
- *Hinge*: using the core and upper back muscles to stabilize and hold a neutral upper body position, bend forward at the hips then back upright with a slight bend in the knees (e.g., deadlift, kettlebell swing).
- *Lunge*: taking a step forward while bending the knees, keeping the front knee in line with the ankle, and the back knee in line with the hip. Bend the back knee so it comes close to the ground; focus is placed on keeping the torso in an upright position.
- *Plank*: using stabilization muscles (core, postural, and back) to hold the body in a prone position on the elbows and toes while keeping the spine in a neutral, flat position without sagging at the hips or rounding the back.
- *Rotation*: using the hip muscles to stabilize and activate the core muscles to perform a twisting motion to create movement in the upper back (e.g., chopping, striking, swinging) while keeping the lower back stable.

PHYSICAL FITNESS FOUNDATIONS

The primary goal of any fitness plan is to help people reach peak performance and well-being, progressively and strategically, while protecting their safety. Building a physical fitness foundation is like learning the characteristics of operating a rifle before firing it: a Marine must learn how a rifle is assembled and functions as a foundation to operation. The following form the foundation of physical fitness:

- Incorporate frequency, intensity, time, and type (FITT) factors.
- Incorporate the components of a physical fitness plan.
- Structure a plan based on periodization.

Factors of Physical Fitness

The first factor to consider is incorporating the frequency, intensity, time, and type, or FITT (see Figure 1-7). All elements must be considered to provide maximum benefit.

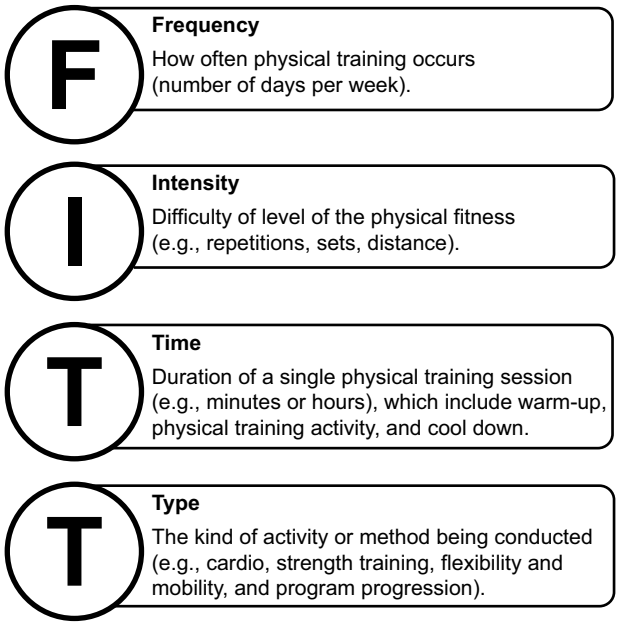

Figure 1-7. FITT Physical Fitness Factors.

Components of a Physical Fitness Plan

The second key factor is that a physical fitness plan has five components. Whereas FITT addresses a physical fitness plan's overall component, the five fitness components address the more specific applications to physical activity. They are—

- *Specificity*: refers to the exercise the body performs, the muscles involved, and the overall training program and its reflection on the required physical tasks.
- *Overload*: increasing resistance or duration above the current threshold. (e.g., increasing the number of push-ups over time).
- *Progression*: advancing by steadily increasing repetitions, sets, frequency, weight, duration, etc. Some considerations when progressing include the following:
  - Only progress through one component at a time.
  - Do not progress too quickly.
  - Adhere to the ten percent rule–progress no more than ten percent beyond the current fitness level.
- *Individuality*: the unique response to physical activity influenced by muscle fiber type, flexibility and mobility, age, sex, fitness level, and health status (e.g., pregnancy, injury, or illness).
- *Recovery*: the recuperation after physical activity to support adaptations and decrease the risk of injury; this is influenced by: time, environment, hydration, nutrition, and active rest. Some considerations for recovery include the following:
  - Active rest requires continued workouts but changing the pattern of routine training to avoid plateaus so the body will continue to make gains.
  - Elements of cross-training provide a common and effective way to combat overuse injuries.
  - The FFIs, and SMIP programs can aid with recovery.

Periodization-Based Structure

The third characteristic involves dividing the physical fitness plan into time segments known as periodization. Periodized training helps plan physical fitness programs into logical periods and addresses the FITT factors and the five physical fitness components. This planning method maximizes training outcomes at specific points of the program, helps prevent injury, avoid physical plateaus, and create individual goals.

PHYSICAL FITNESS PROGRAMS

A balanced physical fitness program should be functional and include training that reflects a Marine's required job responsibilities. Programs should be progressive and focus on proper technique, execution, and recovery. A sound program strengthens the musculoskeletal system, addresses flexibility, mobility, and proper nutrition, and aids in recovery, regeneration, and injury prevention.

Functional Fitness Program Design

Functional fitness is a training system designed specifically to enhance one's performance in life, combat, sport, or activity levels. Traditional training (weightlifting, sports, etc.) is important when attempting to improve physical fitness, but functional training better prepares Marines to adapt and complete known and unexpected operational tasks.

To design an effective program, fitness goals must first be established. Marines should formulate a mission statement and goals, then determine what program stage would signify achieving that goal. There are three program stages:

- *Developmental Stage*: the purpose is to increase muscle mass (hypertrophy), endurance, strength, and power with a gradual progression.
- *Maintenance Stage*: is used to maintain and recover from the development stages of a physical fitness program and it is vital to future progression.
- *Recovery Stage*: the focus is placed on preventing injury and integrating the four MCTF domains to promote holistic health and well-being.

Developing a functional physical fitness program takes into account two main objectives. First, physical training should reflect tasks a Marine is required to perform (i.e., known or anticipated operational tasks). Second, emphasis should be placed on injury prevention.

Developmental Stage. The developmental stage should be progressive and gradually reach a peak of fitness and skill. There are three phases in the developmental stage: hypertrophy and endurance, strength, and power (see Table 1-3).

Table 1-3. Three Phases of the Developmental Stage.

Phases	Duration	Objective(s)	FITT Factor(s)
Phase One: Hypertrophy and Endurance	Two-to- six weeks.*	Build muscle mass and cardiorespiratory endurance.	Low intensity-high volume.
Phase Two: Strength	Four-to-eight weeks.	Increase muscular strength and maintain endurance.	• Increase intensity. • Increase distances. • Small decreases in volume.
Phase Three: Power	Three-to-six weeks.	Improve muscular power Proper recovery.	• Increase resistance and weight. • Decrease volume. • Incorporate speed and agility work.
NOTE *Varies with the Marine's starting fitness level.			

Maintenance Stage. The human body can only progress to a certain level during a specific timeframe. This stage is used to maintain, as well as recover from, the physical fitness program's developmental stages, and it is a vital pause for a Marine's physical fitness progression. Once a goal is met, the Marine should focus on maintaining current physical gains by incorporating shorter training workouts.

Recovery Stage. Despite its critical role, recovery is often a neglected part of physical fitness programs. It is important that an individual identify strenuous training days and durations and plan follow-up recovery events or rest periods. Reducing the intensity after a hard training day or period provides the body time to repair and rebuild. Not giving the body time to recover compounds seemingly insignificant damage over time and can result in a significant injury.

Physical Fitness Program Structure

A well-rounded functional program structure is based on the FITT factors, the five fitness components and a periodization-based structure. Setting clear goals and acknowledging each Marine's unique fitness-level and how each body responds to exercise can a help program succeed. Program structure should include the following:

- *Dynamic warm-up*: integrates flexibility and joint stabilization exercises before any activity that requires physical preparation.
- *Cool down:* primarily composed of static stretching exercises to help increase flexibility and improve recovery.
- *Cardiorespiratory training:* increases the efficiency of the respiratory system during physical activity; includes aerobic and anaerobic conditioning.
- *Resistance training*: increases and maintains muscular strength, endurance, and power.
- *Neuromotor training:* enhances nerve impulses to the muscles to maintain and improve motor control that includes balance, proprioception, agility, coordination, and gait.
- *Recovery training*: includes passive and active recovery to allow the body to heal after strenuous training and operations:
  - Passive recovery refers to periods that dramatically limit or restrict all activity.
  - Active recovery refers to periods that reduce training intensity and time to focus on creating an ideal situation for the body to recover.

Goal Setting. Goal setting is an vital component of program development. It uses the SMART mnemonic (specific, measurable, achievable, relevant, and time-bound) to clearly define goals. Marines create short- and long-term goals based on the various training cycles throughout the program and consider regularly reviewing and reassessing to ensure safe and honest results.

Establishing goals is not exclusive to the physical fitness domain. When a Marine can identify a physical weakness that needs improvement and set a SMART goal for that weakness, they should also identify weaknesses in the other three MCTF domains that might influence physical shortcomings.

Strength Training Parameters. Training load is the total weight lifted or amount of work performed over time. Increasing the daily (acute) load in training improves a Marine's overall ability to perform. Long-term (chronic) is applied over multiple days or weeks. Strength training parameters must be monitored and adjusted to include all additional physical activity in the Marine's schedule to avoid overtraining and injury. Parameters include—

- *Load*: the one-repetition maximum (1RM) percentage, which is the heaviest weight lifted for one repetition.
- *Repetitions:* number of times the movement or exercise is performed overall.
- *Sets:* groups of a specific number of repetitions (e.g., two sets of 15 repetitions).
- *Rest:* the amount of time the body rests between each set.
- *Recovery*: the amount of time the body is recovering and rebuilding between each training session.

Parameters are determined by the targeted fitness component (see Table 1-4), 1RM, number of muscles and body regions, training period, and current fitness level. Additionally, the load percentage influences repetition, sets, rest, and recovery. As the load increases, repetitions decrease, and rest periods increase. A strength program should begin by establishing a foundation based on the individual's muscular endurance (hypertrophy).

Table 1-4. Strength Training Parameters Based on Identified Fitness Goals.

Goal	Load Percent	Repetitions	Sets	Rest	Recovery
Muscular Endurance	≤ 60	15 or more	2 to 3	Up to 30 seconds	24 hours
Hypertrophy	60–80%	8 to 12	3 to 6	30 to 90 seconds	48 hours
Muscular Strength	80–100%	Up to 6	2 to 6	2 to 5 minutes	48 hours
Power (repeat efforts)	30–80%	3 to 5	3 to 5	2 to 5 minutes	48 hours
Power (single effort)	80%	1to 2	3 to 5	2 to 5 minutes	48 hours

Measuring Training Intensity. The training intensity level directly affects a Marine's ability to recover. The two recommended methods to measure training intensity are using self-measurement techniques and using heart rate.

The first method is to use self-measurement techniques that include the rate of perceived exertion (RPE) and repetitions in reserve (RIR) (see Table 1-5). These measurements vary among individuals and are a subjective measurement. The RPE is measured on a scale of 1-10, and it is rated on the self-perceived effort at any time during physical activity. It allows individuals to reflect and adjust training intensity to prevent overtraining and injury.

Repetitions in reserve represent how many movement or lift repetitions a Marine performs before having to stop. Lowering the intensity allows for higher repetitions, and raising intensity decreases the amount that is physically possible. Guided RPE and RIR levels help determine the effort required to reach the intensity level required for the task.

Table 1-5. Perceived Exertion and Repetitions in Reserve Scale.

RPE Level	Intensity	Activity Description	RIR
1	No effort at all	Sitting lying down, or stretching.	20
2	Extremely little	Intermittent walking with little effort.	15
3	Very easy	Sustained walking, light carrying—could maintain the effort all day.	10
4	Easy	Marching, running slowly, light lifting—could maintain the effort for hours.	8
5	Moderate	Running long, ruck marching—breathing heavily as the challenge increases.	6
6	Somewhat hard	Sustained circuit training, running above aerobic endurance—feeling it.	4
7	Hard	Short of breath—using short sentences to speak. Approaching maximum weight.	3
8	Very hard	Pushing limits of weight, pace, and distance—cannot maintain the pace.	2
9	Very, very hard	Close to maximum—can barely breathe to speak.	1
10	Maximum effort	Reached maximum weight, repetitions, distance, or pace—cannot do any more.	0

The second method is using heart rate to determine a predetermined target zone to reach the desired fitness component (aerobic, anaerobic, or recovery) (see Table 1-6). Resting heart rate (RHR) refers to the beats per minute (bpm) when not performing physical activity. Monitoring RHR can be a good way to measure rest and cool-down periods. Low RHR typically indicates an individual has a high physical-fitness level and an elevated RHR can indicate an individual has a low physical-fitness level or possible medical issue. Poor sleep, nutrition, hydration, and stress control can negatively affect a resting heart rate. Having a good resting heart rate is also important because it is used to calculate maximum heart rate to help measure exercise intensity.

Marines can monitor their heart rate by finding their radial pulse (at their wrist) and counting how many beats occur in a minute. Heart rate monitors with wrist or chest straps provide an easier and more consistent way to track a heart rate. Maintaining heart rate at a specific level or zone, gives Marines objective feedback to help control physical activity intensity.

These zones provide a maximum heart rate percentage to reach and maintain during physical activity. The percentage is determined by which fitness component is being targeted.

Table 1-6. Percentage of Heart Rate Maximum to Determine Training Component.

Zone	Maximum Heart Rate Percentage	Fitness Component	Level of Effort	Endurance Training Percentage
5	90–100	Anaerobic explosive speed	Maximum	10
4	80–90	Anaerobic endurance	Very Hard	30
3	70–80	Aerobic endurance	Hard	10
2	60–70	Aerobic endurance	Moderate	40
1	50–60	Active recovery	Easy	10

Extracurricular Competitive Activities and Sports

Participating in all-Marine sporting events enables exceptional Marine athletes to compete at higher-level competitions, including the Armed Forces Championships, National Championships, the International Military Sports Council, and the Olympics.

The Marine Corps Community Services provides intramural sports programs that are unit-driven. They are available to Marines of all skill levels and support individuals and teams to enhance individual fitness, unit teamwork, cohesion and readiness, and improved quality of life. Varsity sports include individual or team competition that represent higher-level command installations.

Aquatics Maximum Power Intense Training. Aquatics Maximum Power Intense Training is an in-water physical training program that features various high-intensity exercises. It is a unit-driven and leader-led program that increases amphibious readiness while taking some physical stress off the body. It allows Marines of all fitness levels to train together and can be adapted for those recovering from injury. Competitive conditioning activities give alternative training for Marines with temporary physical restrictions.

INJURY AND ILLNESS PREVENTION AND TREATMENT

Injury and illness prevention and treatment are a high priority to the Marine Corps and are essential for helping Marines achieve peak physical fitness. Many injuries are preventable but require Marines to be accountable for their own physical fitness programs.

Common Types of Musculoskeletal Injuries

A musculoskeletal injury occurs when the tissues in the body experience trauma (from mild to severe forces) that cause damage. Injuries are classified into two main categories: acute and chronic. An acute injury has a short and sudden onset, usually because of a specific impact or single event. Acute injuries can be non-contact (no external force, e.g., a muscle strain) or contact (external force, e.g., dropping a heavy object on one's foot).

Chronic injuries have a gradual onset, usually compiled over time with repetitive loads and stress. These injuries are also called overuse injuries, and they are typically caused by overstraining. Examples include stress fractures, impingement, chronic knee pain, and muscle strains.

Common injuries Marines experience are—

- *Contusion*: also known as a bruise; can develop in the skin, muscle, or bone.
- *Strains*: stretch, tear, or rip in the muscle and/or tendon; also known as a "pulled muscle."
- *Sprains*: stretch, tear, or rip in a ligament.
- *Tendonitis*: develops because muscles are being used in a repetitive motion and causes tendon inflammation.
- *Cartilage injury*: tears in cartilage that can be acute or chronic, most commonly occurring in the knee, hip, or shoulder.
- *Fracture*: broken bones most often caused by blunt forces or falls.
- *Stress Fracture*: a bone's response to repetitive stress that creates micro-cracks, which can become full fractures if left untreated.
- *Impingement*: the "pinching" (compression) of one or more structures in the body, most often occurring to nerves, blood vessels, and tendons.
- *Low back pain*: generalized low back pain has various structural or muscular causes.
- *Neck and upper back pain*: equipment requirements can cause generalized neck and upper-back pain, particularly when physical fitness programs do not address muscular conditioning.
- *Concussion*: a mild-traumatic brain injury (TBI) caused by direct force to the head (e.g., projectile or hitting the ground), or rotational, accelerated, or decelerated forces (e.g., blast forces). Post-concussion syndrome might develop as a complication.

NUTRITION

Food is the body's fuel for performance. Optimal nutrition allows a Marine to operate at peak physical fitness, but improper nutrition can diminish performance. Consumption and food choices need to be intentional and strategic to maximize training. Planning and keeping proper nutrition practices both in and out of the field help a Marine to maintain and enhance operational performance and morale. Key nutritional strategies help build and maintain nutrition stores in preparation for deployment. Marines should learn to fuel their body by learning appropriate nutritional strategies before, during, and after physical activity or training. Nutrient composition

and timing, combined with adequate rest and recovery periods, are important components of any training program. Fueling properly before completing field operations helps a Marine maintain physical fitness when the mission has priority.

SLEEP

Sleep is foundational to health and is essential to maintaining proper physical fitness because it facilitates tissue repair after physical activity, supports the immune system, and allows hormone synthesis. Unaddressed life and operational stressors can negatively affect sleep health. Disrupted sleep can compromise a Marine's ability to fulfill responsibilities and physical requirements and compromise performance. Establishing good sleep health helps a Marine when time for sleep is not available.

CHAPTER 2.
PHYSICAL FITNESS SELF-ASSESSMENT

The key to maintaining an operational level of physical fitness is to self-assess one's personal health and wellness. A health and wellness self-assessment involves understanding what is good and bad for the body and mind. Every individual has unique traits and circumstances. Similar to maintaining a rifle, a body needs consistent care to function properly, and a Marine should be aware when it is not functioning correctly. Knowing when things are not right with the body directly contributes to a Marine's good health and well-being.

HEALTH AND WELLNESS SELF-ASSESSMENT

The human body has several essential functioning systems. It is important to understand the basic how the human body functions to successfully implement a physical fitness program. When one system experiences a malfunction, it can cause negative effects on others, which decreases a Marine's physical health and fitness. In this publication, each system is discussed independently, but they function collaboratively as a singular, cohesive unit in the body.

Four main body systems (discussed in Chapter 1) directly affect physical fitness: respiratory, cardiovascular, nervous, and musculoskeletal. Each body system provides its unique support and purpose for physical fitness. When one or more systems in the body malfunction, injury and illness may occur.

Self-assessment is the awareness individuals have over their physical health and well-being and can occur in multiple ways. It is the individual's responsibility to understand the basic care provided by medical personnel (corpsman, physician, etc.). Having a baseline understanding what one's "normal" looks like helps a Marine identify an abnormal issue and seek medical intervention sooner. By conducting a self-assessment one can also understand the basic needs of their body, especially during training or during operation-related tasks and better adapt to increased physical stress and demand.

Baseline Assessment

To understand what is abnormal, one must understand what is considered a typical (baseline) assessment. Overall health can first be evaluated by assessing vital signs. Just like at the doctor's office, the first things a Marine should measure are heart rate, blood pressure, temperature, and respiration rate. When these numbers fall outside the average or are inconsistent over time it could indicate possible illness. It is important to know family history and have an annual physical to monitor possible health conditions. When heart rates, blood pressure, or respiration rate are higher than the average, it can indicate that physical fitness is lacking. A Marine who lacks physical fitness is less resilient and lethal.

Heart Rate. Heart rate is the number of times a heart beats per minute (bpm). A Marine should aim to achieve RHRs in the athlete zone (see Table 2-1).

Table 2-1. Average Resting Heart Rates Based on Activity Level and Age.

	Age	18-25	26-35	36-45	46-55	56-65	Over 65
Activity Zone	Athlete RHR	F: 54-60 M:49-55	F: 54-59 M: 49-54	F: 54-59 M: 50-56	F: 54-60 M: 50-57	F: 54-59 M: 51-56	F: 54-59 M: 50-55
	Excellent RHR	F: 61-65 M:56-61	F: 60-64 M: 55-61	F: 60-64 M: 57-62	F: 61-65 M: 58-63	F: 60-64 M:57-61	F: 60-64 M: 56-61
	Good RHR	F: 66-69 M:61-65	F: 65-68 M: 62-65	F: 65-68 M:63-66	F: 66-69 M: 64-67	F: 65-68 M: 62-67	F: 65-68 M: 62-65
	Average RHR	F: 74-78 M: 70-73	F: 73-76 M: 71-74	F: 74-78 M: 71-75	F: 74-77 M: 72-75	F: 74-77 M: 72-75	F: 73-76 M: 70-73
	Poor RHR	F: over 85 M: over 80	F: over 83 M: over 82	F: over 85 M: over 83	F: over 84 M: over 84	F: over 84 M: over 82	F: over 84 M: over 80

Blood Pressure. Blood pressure is the amount of force blood pushes on arteries when the heart pumps blood to the body. It increases during exercise because muscles need more oxygen to create energy. Blood pressure measurements (Table 2-2) are most accurate when taken by a medical professional, but personal and at-home devices such as wrist monitors can be used to monitor blood pressure when a physician recommends. High blood pressure can be caused by a sedentary or unhealthy lifestyle (poor nutrition, smoking, lack of exercise, etc.), but can also be hereditary. Even the most fit Marine can be susceptible to high blood pressure and its negative side effects, such as heart attacks and stroke, if high blood pressure is present in the family's medical history.

Table 2-2. Blood Pressure Measurement Categories

Category	Systolic (mm Hg)-Upper Number	And/Or	Diastolic (mm Hg)-Bottom Number
Normal	Less than 120	And	Less than 80
Elevated	120–129	And	Less than 80
Hypertension Stage 1	130–139	Or	80–89
Hypertension Stage 2	40 or higher	Or	90 or higher
Hypertensive Crisis (immediately consult a doctor)	180 or higher	And/or	20 or higher
LEGEND Hg Mercury			

Respiration Rate. Respiration rate is the number of breaths (inhale and exhale equals one) per minute. Normal respiration rate at rest for adults is 12 to 16 breaths per minute. This rate increases as the intensity of activity increases and should return to baseline during a cool-down routine. An increased respiration rate can indicate an illness or other possible medical conditions, particularly during activity, and it can indicate the presence of medical conditions such as asthma.

Self-Examination and Screening. Being familiar with one's body is key to identifying an injury or illness early on. Self-examinations and screenings are important for serious diseases such as cancer, and noticing body changes can lead to early detection and treatment, which helps keep the disease from becoming more severe. Common self-exams include skin and mole checks, and breast and testicular exams. For example, Marines who fly, regularly experience increased and stronger exposure to dangerous sun rays, and performing frequent skin checks can help them identify abnormal moles or skin spots that could be cancerous.

Of note, experiencing increased fatigue despite getting quality sleep and nutrition, sudden changes in appetite, dramatic changes in weight, or nagging pain during simple movement can all indicate an underlying issue that needs medical evaluation.

PHYSICAL FITNESS LEVELS

There are many ways to self-evaluate physical fitness levels. Marines must reach and maintain a high standard of physical fitness to be resilient during easy and difficult times. The Marine Corps has established guidelines for physical testing that include the PFT and CFT, which are administered annually for all Marines. This is one way to help monitor overall fitness, but further measures should be taken to address each physical fitness fundamental. Marines who have a high level of physical fitness and can self-evaluate contribute to mission readiness.

Cardiorespiratory Fitness

Cardiorespiratory fitness includes both aerobic and anaerobic exercise. Aerobic fitness can best be measured when Marines conduct high-endurance activities such as long-distance running or navigation exercises. Anaerobic fitness is best assessed with activities involving short and powerful bursts of energy such as powerlifting and sprinting. Factors can be measured and tracked over time to identify increases or decreases in an individual's performance (e.g., time or distance).

An example of decreased aerobic endurance would be lengthened run times during the PFT, often accompanied by rapid or increased difficulty breathing and more intense fatigue. Decreased anaerobic fitness can be observed in activities such as slow times during the maneuver-under-fire activity or experiencing trouble performing a rope climb.

Muscular Fitness

Poor muscular fitness indicators can include a quick onset of fatigue during activity, increases in overuse injuries, and more time needed for recovery after intense activity. Marines can track and improve their muscular fitness by changing the—

- Sets and repetitions (involves decreasing the number of sets performed with normal weight).
- Weight (involves decreasing the weight used).

Each of the following are muscular fitness component examples Marines can look for as indicators of decreasing or lower capability levels:

- *Strength*: unable to perform a buddy carry during CFT.
- *Power*: unable to lift artillery ammunition or perform a rear-hand punch.
- *Endurance*: repetitions performed in the CFTs ammo can lift.

Flexibility and Mobility

Flexibility and mobility allow the body to move through ranges of motion, but too little (hypomobility) or too much (hypermobility) can cause decreased performance or cause an injury. Decreased flexibility means the muscles do not stretch as much as they should for a specific action. For example, a tight hamstring can decrease stride length while running, which becomes inefficient because it would hinder the runner from covering a certain amount of distance. One has to create double the work within one step for the muscles to make up for losing distance. This could lead to increased fatigue, increased recovery time, decreased fitness scores and cause injuries, such as muscle strains or tendonitis.

A decrease in mobility means the body might not move smoothly, safely, or in its ROM. For example, tight calf muscles on the back of the lower leg (gastrocnemius and soleus) can decrease upward pointing (dorsiflexion) ROM at the foot and ankle. Because they consistently wear boots, Marines should protect their feet. Not addressing the lower leg's flexibility could lead to pain or injury. It can also lead to poor form in physically demanding tasks, such as squatting, which is a common movement. Using poor form while squatting, such as when lifting an object, can often cause back and knee injuries (see Figure 2-1).

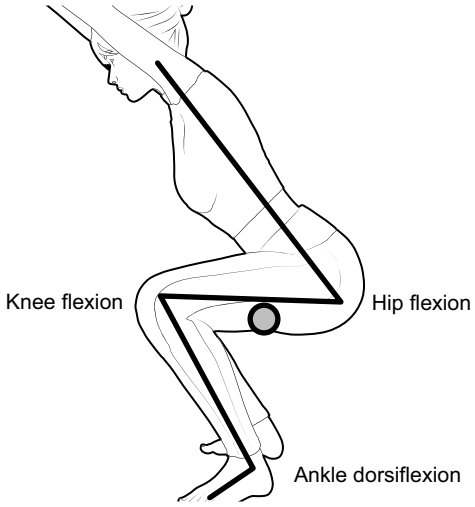

Figure 2-1. Example of Mobility in a Proper Squat.

On the other end of the spectrum, hypermobility, or excess movement at the joints, can also cause injury. The common term for this is "double-jointed." People do not have multiple joints at one site, but it helps describe individuals who have joints that move beyond what is considered normal motion at a joint. Baseball pitchers often experience hypermobility at the shoulder. To produce the power needed to throw the ball, a pitcher's shoulder typically has more external rotation than the average person. This leads to injuries such as ligament ruptures that could require an ulnar collateral ligament reconstruction, more commonly referred to as "Tommy John." When a joint has excess mobility, it can become unstable and place stress on other parts of the body, which can lead to serious injuries such as dislocations or ligament ruptures.

A Marine can self-assess flexibility and mobility by comparing right and left body parts to each other. For example, to see if one ankle has less flexion than the other, sit with the feet off the edge of a bed or chair with enough room that the feet can move up and down. Move the feet so they go

as far up as they can, then point them down as far as they can (see Figure 2-2). Less motion on one leg may indicate the muscles are tight. One might also feel a pull or stretch on one leg more than the other, indicating muscle tightness.

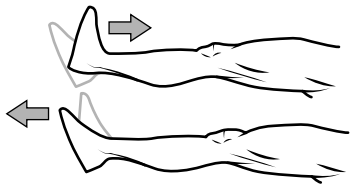

Figure 2-2. Example of how to Self-Assess Calf Muscle Tightness.

Balance and Proprioception

Balance and proprioception are two different components that work together to create coordinated and safe movement during physical activity. Marines must have good balance and proprioception to perform tasks like firing a weapon or navigating uneven terrain at various speeds.

There are a few ways to self-assess balance and proprioception, but guidance from a athletic trainer or strength coach can be beneficial for accurate measurements. One simple way to assess balance is a modified Balance Error Scoring System (BESS) test. Marines can perform the BESS test on themselves by going through the three stances on flat ground (see Figure 2-3). Balance errors can also be more accurately counted with a buddy.

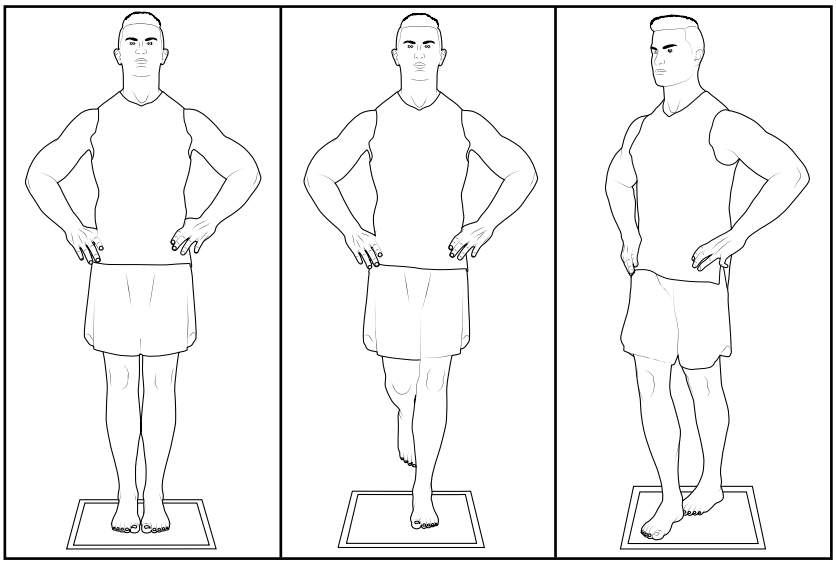

Figure 2-3. Double Leg, Single Leg, and Tandem Leg Stances (Left to Right) for the Balance Error Scoring System Test.

Qualified personnel such as FFIs, strength coaches, and athletic trainers can conduct more in-depth BESS evaluations. Marines should seek a qualified medical provider if these personnel are not available.

Biology and Physical Fitness

The male and female bodies have unique biological needs when establishing an efficient physical fitness level. The physical fitness foundation remains the same, but the body's response to physical activity can vary.

Male bodies can build more muscle strength and mass through increased testosterone levels, but female bodies have a greater capacity for increased flexibility and mobility. Training to an individual's biological strengths is important and addressing biological differences can minimize the risk of injury. Male Marines cannot neglect training flexibility and mobility, just as female Marines cannot neglect strength training, because all physical fitness fundamentals are required to make the body ready and resilient.

Women and men also differ anatomically. A female body's pelvic bones and hips are going to create a larger angle from the hip to the knee (known as a Q-angle). This can increase knee injury risk, but including knee injury prevention exercises and weight training, the risk can be managed.

Another example is male bodies have more stiffness in their muscles and tendons than to female bodies. This can decrease mobility, which can increase the risk of injury due to a lack of range of motion. Male Marines performing an ammo can lift can compensate with strength to make sure they get the ammo can completely overhead. Although ammo-can lifts are not an everyday activity, overhead lifting in general is common. Repeatedly lifting overhead while lacking sufficient range of motion can lead to chronic shoulder pain and injury.

INJURY AND ILLNESS

Marines need to know about common injuries and risk factors. This knowledge helps prevent injuries by prompting adjustments to the physical fitness program components that could negatively affect personal and unit combat fitness. There are two different risk types:

- *Intrinsic*: individual characteristics that include demographics (e.g., age and genetic factors), anatomical characteristics (e.g., high arches or flat feet), physical fitness level, and behavior (e.g., motivation, sleep health, and diet).
- *Extrinsic*: conditions outside the individual that include running mileage, training techniques, footwear and other equipment, load, environmental conditions, and leadership.

Sometimes intrinsic and extrinsic factors can be changed to decrease the risk of injury, but other times they are out of the Marine's ability to control. Two risk factor categories include—

- *Modifiable*: factors that individuals can change, such as physical fitness, rest and work periods, tobacco, weight, and movement quality.
- *Non-Modifiable*: factors that are not susceptible to change, such as a family's medical history (e.g., blood pressure or cholesterol), and weather.

Specific Factors that Contribute to Injury

Physical Fitness Levels and Movement Quality. A low level of physical fitness is a modifiable and intrinsic risk factor. Along with previous injury, lacking physical fitness is a risk indicator for potential injury. The following are risks associated with fitness levels:

- Poor cardiorespiratory and muscular endurance increase the risk of injury.
- Poor cardiorespiratory fitness increases the risk for chronic disease, including cardiorespiratory disease, which can lead to heart attack or stroke.

Good movement quality can also reduce the risk for injury by decreasing stress on bones and joints and preparing the body for related tasks. For someone with good movement quality, this means shifting the focus from "How much weight can you squat?" to "Can you squat with proper form?" Improper technique during functional movements like squatting and landing from a jump increases stress on the bones and ligaments in the lower extremity and spine.

Inadequate mobility and range of motion can reduce optimal performance. The more a Marine can train to improve these factors, the more likely the body will automatically perform efficiently and safely, allowing the Marine to focus on more important tasks.

Environment. The environment is extrinsic and cannot be modified. Possible environmental conditions include—

- *Heat and humidity*: can cause sweat rate, core temperature, and heart rate to increase which can reduce an individual's ability to cool themselves, and this can lead to heat illness.
- *Cold*: can increase the risk for dehydration, frostbite, hypothermia, and other cold injuries and, which can lead to muscular injuries.
- *Surface and terrain*: harder surfaces (e.g., asphalt, turf, and indoor courts) can increase the impact on bones and joints, while uneven terrain such as grass, mulch, and wooded areas can lead to acute injuries.
- *High altitude:* increases in elevation decrease the amount of oxygen available, which makes the cardiorespiratory system work harder and makes fatigue happen more quickly.

Equipment Safety. Keeping equipment in a maintained and safe area can minimize injury risk due to malfunction. Equipment safety measures examples include ensuring space around a barbell when performing Olympic lifts is at least four feet, inspecting and replacing damaged gym equipment, or replacing running shoes about every 250 miles as they break down, etc. Properly fitted gear and uniforms such as boots and packs help minimize chronic injury risk.

Previous Injury. A injury is the primary predictor for an injury. Previous injuries are intrinsic and risk factors cannot be modified. Even after an individual has fully recovered from an injury, there is an increased risk for the injury to reoccur. Risks associated with previous injury can include—

- Balance and stability deficits due to ankle or foot sprains that were not properly rehabilitated or fully healed.
- Surgery for a torn ligament or joint reconstruction, which can lead to osteoarthritis.

Permanent changes to damaged tissue will never return to their pre-injury state. To compare, a rip in a pair of trousers can be sewn back up, but even though the fabric is closed again and protects the skin underneath it is not as strong as it was before the tear.

Musculoskeletal Injuries

A musculoskeletal injury is damage to a body's muscles, bones, joints, or connective tissue. If these injuries result from a single incident, they are acute. If they progress over time, they are chronic.

Common Signs and Symptoms of Musculoskeletal Injuries. The body has a process for healing injured tissue and presents with common signs and symptoms for all injuries (see Table 2-3). These common signs and symptoms vary depending on how severe the injury is and can include the following:

- Swelling.
- Warmth.
- Redness.
- Point tender (pain with touching).
- Decreased range of motion.
- Decreased strength.
- Odd sensation (e.g., pop, snap, or crack).
- Difficulty bearing weight.
- Deformity.

Table 2-3. Common Injuries, Causes, and Prevention

Injury	Body Parts	Common Cause(s)	Prevention
Sprains	Ankle Shoulder Wrist Knee	External force(s) or movement that pushes the joint past its typical ROM. Example: falling on an outstretched hand or a quick change in direction with the foot planted.	• Gradually building muscle strength. • Safe training environments (e.g., padding). • Instructors demonstrating proper falling techniques.
Strains	Hamstring Hip Flexor Rotator Cuff	Overstretching during flexibility or mobility training. Stretching a muscle past its endpoint during movement.	• Dynamic warm-ups and cool down. • One extra flexibility and mobility training session per week. • Balanced muscle strength progression.
Tendonitis	Knee Achilles (heel) Shoulder	Insufficient progression that adds more stress. Example: distance running with no endurance built up.	• Safe and steady progression that sets a muscular strength and endurance foundation. • One more flexibility and mobility training session per week.
Cartilage	Knee (meniscus) Shoulder (labrum) Hip (labrum)	Acute or chronic injuries from compression and other forces combining at the same time. Commonly occurs with other injuries such as a dislocation or ligament rupture.	• Practice proper form and strengthening to minimize the risk of poor joint mechanics. • Strengthen muscles above and below the joint to create more stability.
Fractures	Feet Lower legs Wrist and Hand	Falling on an outstretched hand, from a height, or in an awkward landing position.	• Ensure safe training conditions. • Instruct proper falling techniques. • Include the recommended amount of nutrients in a diet to promote bone health.

Table 2-3. Common Injuries, Causes, and Prevention (Continued).

Injury	Body Parts	Common Cause(s)	Prevention
Stress Fractures	Feet Lower legs	Overuse, repetitive movement under heavy loads. Insufficient nutrient intake.	• Safe progression of weight-bearing physical activity. • Gradual load increase. • Properly fitted footwear or orthotics.
Impingement	Shoulder	Under too much load too soon and too often. Overuse of overhead activities.	• One extra flexibility and mobility training session per week specifically for the upper body. • Safe and steady progression of a physical fitness program. • Proper recovery following upper body physical activity.
Low Back Pain	Lumbar spine	Poor posture with weak core muscles. Acute injury such as a fall. Chronic stress over time on the spine causing a herniated disc.	• Focus on deep-core activation and strengthening. • Increase upper back and hamstring mobility. • Use proper form and technique for lifting and other manual work.
Dislocations and Subluxations	Shoulder Fingers	External force causes the joint to be out of alignment. Example: falling onto an outstretched hand or elbow, or a shoulder forced past its limits while grappling.	• Strengthen the muscles that surround the joint to increase stability. • Incorporate more proprioception exercises to increase joint stability and responsiveness.
Shin Splints	Lower legs	Quick changes in physical activity intensity, type of exercise, or surfaces. Improper or old footwear.	• Safe and steady progression of a physical fitness program. • Proper footwear or orthotics. • Increase the gastrocnemius and soleus muscle flexibility. • Increase the intrinsic foot muscles and anterior lower leg muscle strength.

Pain. Being able to self-assess pain is key to using a physical fitness program and surviving in the field. An individual must first determine whether the discomfort or pain is normal for recent physical activity. For example, during martial arts training, a Marine might sustain contusions or experience muscle soreness from unfamiliar exercise. These things should be expected with this type of training, but if the pain level is significant enough that a Marine cannot safely perform their job tasks, they should seek medical care. Using a zero-to-ten pain scale is a good tool to self-assess pain. Figure 2-4 depicts a pain scale.

While executing an operation, a Marine may have to tolerate pain until care can be administered. Marines who understand their bodies and the pain they might experience can remain resilient and make necessary adjustments to movements while contributing to mission success.

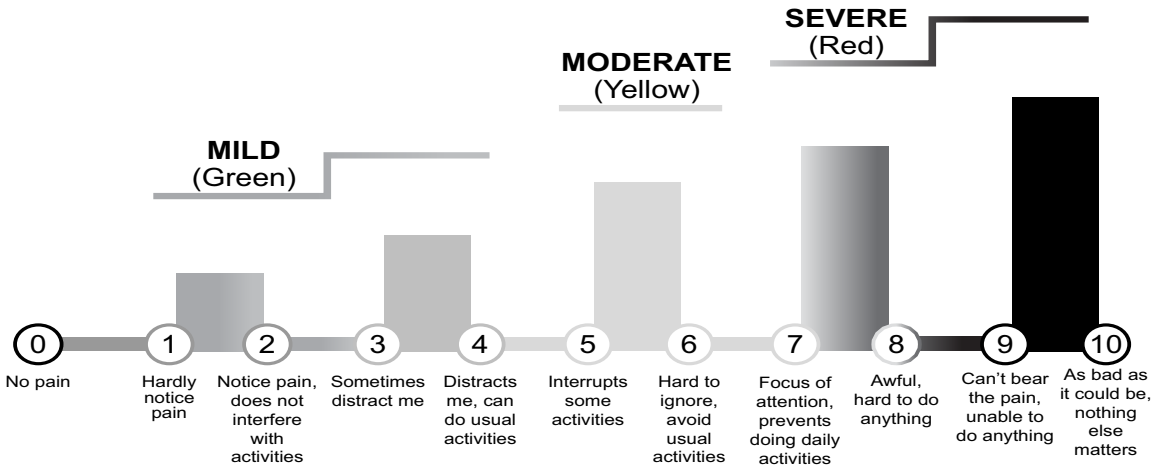

Figure 2-4. Pain Rating Scale.

Sudden Death Conditions Related to Physical Training

Dehydration. Dehydration occurs when body fluid and electrolyte loss from sweating and urination exceeds fluid intake. It can negatively affect physical performance, cognitive abilities (e.g., decision-making), and mental health. In addition, it increases the risk of heat illness, including heat cramps, heat exhaustion, and heat stroke, as well as rhabdomyolysis (all of which can be fatal). Fluid loss is greater during exercise with a long duration, and when it is hot or humid. However, it is important to remember that fluids are lost even when individuals do not sweat or they sweat very little, such as at higher altitudes, when it is cold, and during low-intensity physical activity. Table 2-4 provides a list of symptoms indicating mild to severe dehydration.

Table 2-4. Signs and Symptoms of Dehydration.

Mild to Moderate	Severe
• Thirst. • Headache. • Dizziness or light-headedness. • Dark yellow urine. • Dry or sticky mouth. • Decreased urine output. • Sleepiness or fatigue. • Constipation. • Dry skin.	• Extreme thirst. • Severe headache. • Irritability or confusion. • Unconsciousness or delirium. • Behavioral changes. • Very dark yellow or amber-colored urine. • Rapid breathing and heart rate. • Lethargy. • Vomiting.

Dehydration is a common experience for all Marines and recognizing its signs and symptoms can be the difference between survival or severe illness, even death. While in the field, Marines and their leadership should do everything possible to remain hydrated and to be conscious about how and when energy can be preserved versus used.

Heat-Related Injuries. Heat illness is a constant risk for Marines. There is a heat-illness progression that signifies declining physical status. Heat illness not only negatively affects one's physical abilities but can lead to LIMDU assignment. Marines with heat illness can significantly slow down a unit and compromise the mission. Leaders should use available resources and take preventive heat-illness measures to prepare their Marines as best possible.

If Marines experience severe heat illness, a physician should evaluate them and review their complete blood work (possibly multiple times). They should be monitored as they complete their return to full duty and progress toward physically demanding tasks. Dehydration is the first symptom Marines present in heat illness, and it can quickly progress to heat exhaustion and heat stroke.

If a Marine starts to develop dehydration symptoms, fluids should be ingested, and activity should be modified or discontinued. During a mission, a Marine may not be able to cease activity, so careful planning and preparation should be completed before starting the task. If symptoms are not treated, severe heat illness can occur, which can incapacitate the Marine and put a burden on others in the unit to assist them. Marine Corps Reference Publication 3-40A.9*, First Aid,* should be reviewed for guidance on how to properly identify and provide first aid care for heat injuries.

Hyponatremia. Hyponatremia is overhydrating (drinking too much water) in a short amount of time, which causes sodium levels to become dangerously low. Sodium is essential for heart function, and when the heart cannot function properly the body begins to shut down and it can lead to death. The amount of water it takes to cause hyponatremia varies among individuals based on genetic factors, activity levels, and environmental factors such as heat. Individuals who have experienced a heat illness might feel the need to do this to avoid future heat illness. When hydrating, it is important to drink until no longer thirsty and pay attention to other factors such as how much sweat is being produced to help prevent hyponatremia.

Exercise-Induced Rhabdomyolysis. Exercise-induced (exertional) rhabdomyolysis is a potentially fatal condition when the muscles cannot keep up with the energy demand caused by intense exercise. It involves muscle fibers breaking down, resulting in toxic contents releasing into the blood. High volume and vigorous exercise with minimal recovery and/or low physical fitness levels often result in rhabdomyolysis. Rhabdomyolysis can lead to rapid kidney failure and death. It does not discriminate and can affect any Marine. Most Marines likely know a fellow Marine who has had exertional rhabdomyolysis, and some have experienced it themselves.

An exercise-induced rhabdomyolysis crisis presents with exhaustion and Marines complaining about cramping, tightness, or pain, but the muscle remains flaccid (not contracted). Swelling localizes to one muscle group and urine is a dark brown or black color the toxic contents cause in the blood. Marines should prepare to avoid exercise-induced rhabdomyolysis because the damage it causes to muscles and organs leads to LIMDU, physician clearance, bloodwork, and a slow progression back to full-duty responsibilities. Having a a well-rounded physical fitness program, good nutrition, and being aware when the body is in distress and asking for medical assistance are key.

Difference Between Illness and Disease

It is important to recognize the difference between illness and disease and their negative effects on physical fitness. An illness is pain or discomfort that may or may not have an identified cause. A disease might present differently and not have pain or discomfort, but it does have an identified cause. The flu is an example of an illness and can be very contagious and spread through the air when a person coughs or sneezes. Lyme disease is an example of a disease with an identifiable cause. A bite from an infected tick causes Lyme disease. Both can cause similar symptoms such as muscle aches, but the root cause of Lyme disease is specific, whereas the flu would have spread in multiple ways.

Illness and disease can decrease cardiorespiratory endurance and muscular endurance, which negatively affects the other physical fitness factors. The longer an illness or disease affects the body, the longer a Marine may be unable to complete physical responsibilities, resulting in LIMDU status. Illnesses can typically be self-managed (based on length and severity of symptoms), while diseases are diagnosed by a physician. Marines should seek out medical care when symptoms cannot be self-managed.

Body Image Disorders

Body image disorders affect both men and women, particularly in an extremely physically fit environment that requires high standards and expectations. There are different body image disorders that require mental healthcare provider diagnoses. Understanding the body image disorder's risks and causes can help a Marine avoid or recover in a healthy manner. Body image disorders are the deeper cause that can present in ways such as constant injuries, exhaustion, and cognitive fatigue. Untreated body image disorders negatively affect a Marine's ability to perform required responsibilities and can lead to LIMDU or even death. Some related conditions include the following:

- *Relative Energy Deficiency Syndrome (RED-S):* formerly known as the Female Athlete Triad, this is a health concern for physically active women, who have disordered eating, amenorrhea (irregular or absent menstrual periods), or osteoporosis (low bone mass).
- *Muscle Dysmorphia:* is an obsessive preoccupation with overall muscularity, size, and leanness and preoccupation with minor (real or perceived) body imperfections.

NUTRITION

Nutritional intake is a modifiable and intrinsic risk factor. A well-rounded diet that includes proper nutrients is essential for exercise performance and recovery. Physical appearance and stature do not always indicate a healthy diet. Marines can perform well physically on a diet that is not nutritious and consists of fatty and unhealthy foods, yet this impedes their physical potential and can cause long-term damage to their health. With the proper fuel (a nutritious diet), many Marines could see dramatic improvements in their physical fitness and overall health. In this and future discussion of nutrition in this publication, the reader should note that a mix of imperial and metric measurements are used. This is due to the standards universally used in the nutrition and sports performance settings and context.

Baseline Nutrition Assessment

Marines can begin to monitor their nutrition through making changes in their baseline health. This can include monitoring body composition (weight, muscle mass, percentage of body fat, etc.), energy levels throughout the day, bathroom frequency and regularity, the outward appearance of skin, hair, and nails, and the frequency of hunger pangs and cravings. Any Marine who is struggling or moving away from their baseline, or is unable to complete everyday tasks, should seek out a medical professional to rule out underlying issues. Signs and symptoms of baseline deviations could include brittle nails, hair loss, constipation, or unexplained weight loss or gain.

An in-depth nutrition assessment is an evaluation performed by a qualified practitioner (e.g., a registered dietician). It is an objective and subjective data analysis related to food and nutrient intake, lifestyle, and medical history. Qualified practitioners evaluate the nutritional status which leads to a care or intervention plan designed to help attain or maintain a healthier status. Semper Fit is a free program offered through MCCS for all active-duty Marines and offers nutrition services and education. The services vary based on the installation.

Performance Nutrition

Proper nutrition is crucial for warfighters to optimize their performance for training and missions. The nutritional fitness platform contains food items on the master menus that meet the required military requirements listed in Marine Corps Order (MCO) 10110.49, *Menu Standards for Human Performance Optimization*. Marines often disconnect because they do not have enough nutritional knowledge, experience menu fatigue, or become bored with available food choices.

Military training is challenging in less-than-optimal conditions for Marines, unlike elite athletes who may train in optimal settings. To help counter less-than-optimal conditions, targeted nutrition can reduce muscle fatigue, decrease recovery time between missions, and improve mental function. When performance fueling is not strategic and intentional it increases the likelihood of underperforming and injury. Figure 2-5 provides examples of food that help restore deficiencies based on body function.

Marines who balance energy and nutrient intake to maintain peak performance have a competitive edge over the enemy.

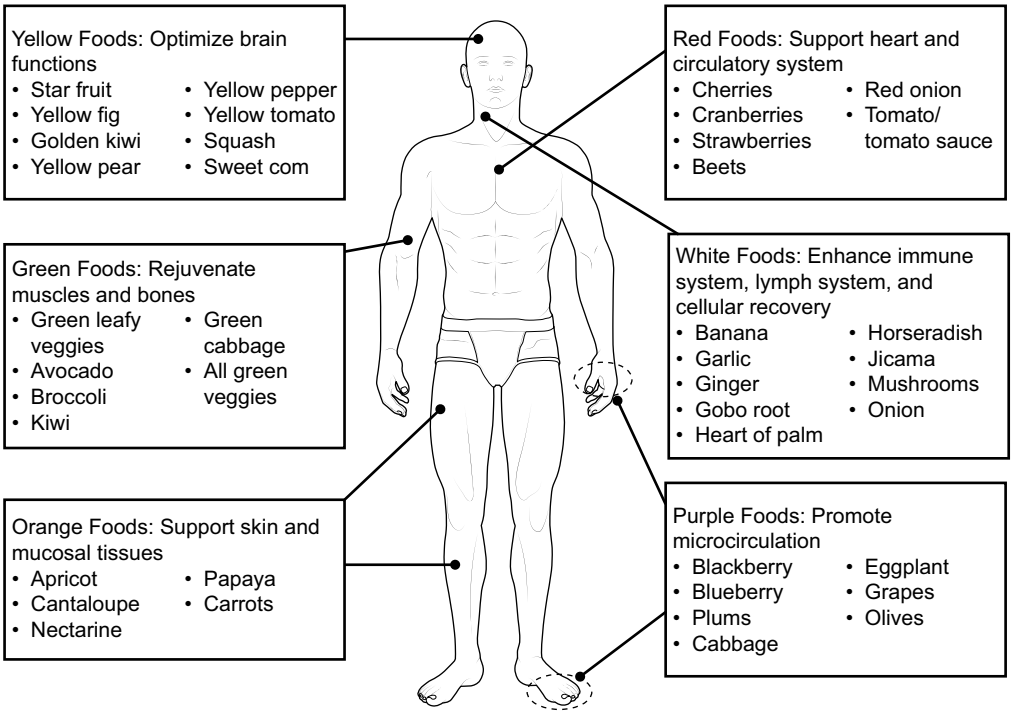

Figure 2-5. Example of Foods for Optimal and Restoration Nutrition.

Energy Balance. Energy balance represents the balance between calorie intake and output (expenditure). A calorie (kcal) is the basic energy unit measurement in food. Calories are energy units that fuel our bodies. Without sufficient calories, our heart would not beat, our lungs would not function, and our brain would not work. Calorie requirements vary with age, metabolism, activity level, and body size.

Maintaining energy balance is a critical aspect of optimizing performance in active populations, particularly when energy output is high. Two major contributors to estimated energy requirements are basal metabolic rate and physical activity. Another influencing factor is energy, which is needed for digesting, absorbing and metabolizing foods. This is called the thermic effect of food. The body needs energy to sustain life (i.e., pumping blood, breathing), conduct physical activity, and break down food to obtain nutrients and create more energy. This is why physically demanding jobs and lifestyles need to meet the calorie requirements to maintain the energy being used. Energy balance can change day-to-day depending on the amount and type of physical activity being performed.

For example, a Marine who is completing an endurance event (e.g., six-mile run, 12-mile hump, or martial arts training) can benefit from increasing their fuel source (calories from nutrient-dense food) to have enough energy to perform and recover at a higher standard. A Marine needs to increase their fuel source to have enough energy to succeed. This energy demand is likely greater on days the Marine is completing an endurance event.

Nutrients

Nutrients are substances that are essential for growth and the maintenance of life-sustaining functions. They are broken down into two classes: macronutrients and micronutrients. Macronutrients provide energy in the caloric form, whereas micronutrients do not. The six essential nutrients are carbohydrates (carbs), proteins, fats, vitamins, minerals, and water.

Macro-Nutrients. Food makes a difference in performance, health, and quality of life. The body needs energy from carbohydrates, fats, and proteins, but it uses whatever is available. If nothing is available for energy, the body starves and breaks down muscle and other tissue for fuel, which greatly reduces physical and mental performance and can lead to fatal conditions such as rhabdomyolysis. Macronutrients come from three main sources of energy, carbohydrates, proteins, and fats. These fuels are called macronutrients and should be consumed in large quantities (the prefix “macro” means large). Macronutrients are the a performance diet’s main component. No single macronutrient is better than another; a combination is the best formula.

Carbohydrates. Carbohydrates are the body’s main energy source. They are chains of small, simple sugars that are broken down and enter the body as glucose. Glucose is essential for the body, as it is the preferred energy source in the brain, heart, and central nervous system. For this reason, 45 to 65 percent of a performance diet should consist of carbohydrates.

Carbohydrates are found in many foods but should be limited in sweet foods with excess sugar. Healthier options include fruits, vegetables, beans, nuts, and whole grains. These foods also contain fiber. The body cannot digest fiber, but fiber helps the intestine expel waste, can help lower cholesterol, and acts as a “time release” component, which controls blood sugar levels.

Carbohydrates are classified as either simple or complex, based on their structure. Simple carbohydrates digest quickly, while complex digest slowly. Some foods, such as fruit, are simple in structure but are considered slow carbohydrates because their fiber content slows digestion. Complex carbohydrates come from plant materials and generally digest more slowly (or not at all). Examples of simple and complex carbohydrates include the following:

- *Simple*: white or brown sugar (sucrose), fruit sugars (fructose), milk sugar (lactose), honey, corn syrup, high-fructose corn syrup, maple syrup, and molasses.
- *Complex*: grains, fruits, seeds, potatoes, pasta, peas, beans, and other vegetables.

Use Table 2-5 to calculate how many grams of carbohydrates to eat based on bodyweight and activity level.

Table 2-5. Carbohydrate Needs Based on Activity Level.

Activity Level	Carbohydrate Needs*
Light (low-intensity or skilled-based activities)	3 to 5
Moderate (moderate exercise program; about one hour per day)	5 to 7
High (endurance program; 1–2 hours per day of moderate to high-intensity exercise)	6 to 8
NOTE *Grams per Kilograms Bodyweight	

Protein. Protein is built by amino acids, which are linked together in complex formations. They are important for building, maintaining, and repairing body tissue (e.g., muscles). There are 20 different amino acids, nine of which are considered essential because our bodies cannot produce them naturally and they must be obtained through food. Proteins that contain all 20 amino acids are called complete proteins. Complete proteins are found in animal products such as meat, eggs, and milk. Soy protein is a vegetable product that is considered a complete protein. Marines who choose to minimize or omit animal proteins in their diet can combine incomplete protein products to achieve the same optimal results in performance.

Protein should make up about 10 to 35 percent of a diet. A general rule is if the plate at each meal is one-quarter to one-third covered with a protein-rich food, it provides the amino acids needed to build and repair muscles. Consuming an excess amount of protein in natural or supplemental form does not alone promote a greater increase in muscle mass.

Whole foods are preferred over supplements, as they can meet an individual's protein needs. For optimal fueling, include protein at meals and in snacks throughout the day and after strenuous activities Protein sources include the following:

- *Plant Sources*: beans, peas, nuts, seeds, tofu, and small amounts of grains and vegetables.
- *Animal Sources*: beef, fish, seafood, poultry, pork, dairy, milk, cheese, and yogurt.

Table 2-6 provides good sources of protein.

Table 2-6. Examples of Protein Sources.

Food	Protein (in Grams)
Sirloin steak, 5 ounces	42
Chicken breast, 5 ounces	40
Pork chop, 5 ounces	38
Atlantic cod, 5 ounces	32
Non-fat Greek yogurt, strawberry, 5.3 ounces	12
Low-fat milk, 8 fluid ounces	8
Black beans, 12 ounces	7
One hardboiled egg	6
Almonds, 1 ounce	6

Specific protein amounts an individual needs depend on age, bodyweight, training intensity, and activity level. In general, protein needs range from 0.8 to 1.6 grams per kilogram per day. A protein range intake of 63 to 119 grams per day for men and 50 to 93 grams per day for women is recommended. Consume protein at the higher end of the range with intensified training, more frequent training, new training stimulus, low physical fitness levels, or when energy intake is low.

Individuals who do not intake enough calories to meet the body's energy demands (negative energy balance) might need up to two grams of protein per kilograms of bodyweight to maintain muscle mass, strength, and performance. When in severe negative energy balance, (i.e., during intense training, missions, or extreme environmental conditions) more protein might not be enough to preserve muscle mass. In these environments, it is best to focus on getting enough high-quality foods and drinks to help meet energy needs. Eating and drinking more calories helps the body avoid using protein for energy due to the increase in carbohydrates.

Many Marines believe if they eat more protein, their muscles increase in size. However, this is not necessarily true (i.e., the "excess protein myth"). There is no "storage system" for excess protein, so protein must be obtained through daily food intake. Every individual has a muscle mass threshold, which is predetermined genetically (at some point, muscle mass will not increase). Once the daily protein and caloric needs are met, the remaining calories are stored as fat.

Fat. The misconception about fat is that all fat is bad, but it is essential for maintaining a healthy body. The strategy is to eat more "good" fats than "bad" fats. Saturated fat should be minimized, and trans fats should be avoided. Increased unsaturated fat levels and essential fatty acids, such as Omega-3 and Omega-6, can be beneficial. Simple changes to an eating plan can enable an individual to meet the fat intake guidelines. Marines should implement these strategies to include the following:

- Use oils, not butter, when preparing and cooking food.
- Avoid deep-fried foods; try different cooking methods such as baking, broiling, stir-frying, grilling, roasting, and steaming.
- Incorporate more whole grains, beans, legumes, fruits, and vegetables into meals.
- Consume lean protein sources such as fish and shellfish, skinless chicken and turkey, and tofu.

- Eat or drink reduced or non-fat milk, yogurt, and other dairy; or eat smaller portions of full-fat dairy products such as cheese.
- Cut visible fat off meat and drain excess fat after cooking.

Dietary fat sources are described in Table 2-7.

Table 2-7. Types and Sources of Dietary Fat.

Type	Description	Examples of Food Sources
Monounsaturated fats	Liquid at room temperature but solid when refrigerated	Olive, canola, and peanut oils; peanut butter, cashews, almonds, and avocados
Polyunsaturated fats	Liquid at room temperature	Safflower, sesame, soy, corn, and sunflower oils; nuts, seeds, and fish
Saturated fats	Generally solid at room temperature; mainly in animal products but also in some tropical oils.	Whole milk, cream, ice cream, whole-milk cheeses, butter, lard, meat, palm kernel and coconut oils, and cocoa butter.
Trans fats or "partially-hydrogenated" oils	Solid at room temperature. Small amounts are naturally occurring (meat and dairy). Most trans fats are created artificially from polyunsaturated fats.	Fatty parts of meat or milk (small amounts); packaged and processed foods such as cookies, crackers, and baked goods; French fries, donuts, and other commercial fried foods.

Fat has many roles in the human body. One of fat's main functions is protection, which includes cushioning to protect organs, and insulation to maintain the body's temperature. In addition, fat has a vital role in the digestion of fat-soluble vitamins (Vitamins A, D, E, and K), meaning they need fat to be absorbed into the body.

A performance diet should consist of only about 20 to 30 percent fat. Saturated fat intake should not exceed 10 percent and cholesterol should be limited to 300 milligrams per day. However, with operational and restricted rations, a higher fat content may be necessary to increase caloric density and minimize ration weight. Fat intake should be adjusted to fit caloric needs. For example, a Marine reporting to a duty station where they will have consistent exposure to an extremely cold environment and limited food resources, should increase their healthy fat intake to approximately 35 percent of their diet. This helps protect them from hypothermia and create energy stores when calories are not available to consume.

Micronutrients. Micronutrients do not provide energy like macronutrients, but they help to convert food into energy and support performance at a high level. They include vitamins and minerals required by the body in small amounts. Marines require different amounts of vitamins and minerals based on sex, age, activity, and the environment. The best way to obtain them is to include nutrient-dense foods in a daily diet. Lack of micronutrients can lead to injury and illness. For example, decreased vitamin D and calcium levels can lead to stress fractures, which are common in Marines who hike long distances. These calorie-free vitamins and minerals—

- Provide antioxidants (help improve immune function and combat free radicals such as tobacco smoke, ultraviolet rays, and air pollution).
- Transfer and deliver oxygen (improve the cardiorespiratory and myofascial systems efficiency).

- Repair tissue (i.e., muscle damage sustained during physical activity).
- Support body growth and development.
- Aid metabolic processes (provide energy for physical activity).

A Marine should aim to satisfy these micronutrient needs with food, but vitamin and mineral supplements might be useful if one or more of the following issues are present:

- Vitamin or mineral deficiency as diagnosed by a healthcare provider.
- Poor nutrient intake and dietary habits (supplements are not a substitute for a poor diet or under-fueling).
- Physically unable to meet energy requirements from food.
- Exposed to extreme environments such as cold temperatures and high altitudes for prolonged periods.

Taking a general multi-vitamin or mineral supplement has no measurable performance benefit when vitamin and mineral needs are met through food. When considering taking a supplement, first talk with a healthcare provider to ensure safety and prevent taking excess amounts.

Meal Timing and Practices

Guidelines for the timing and amounts of macronutrients to include in the warfighter's diet are based on the essential understanding of how proper nutrition affects physical fitness. Nutrition and meal plan selections for training should reflect requirements in a military operation.

Nutrition makes up the daily intake for everyday training and physical demands, but the refueling and recovery concepts need to be more commonplace within the military construct when discussing fuel for the body. By evenly distributing caloric intake throughout the day (meal timing), a Marine can minimize hunger, curb unnecessary food cravings, and mitigate the desire to compensate by overeating with special occasion foods. Figure 2-6 shows three concepts that help Marines create a winning food plan.

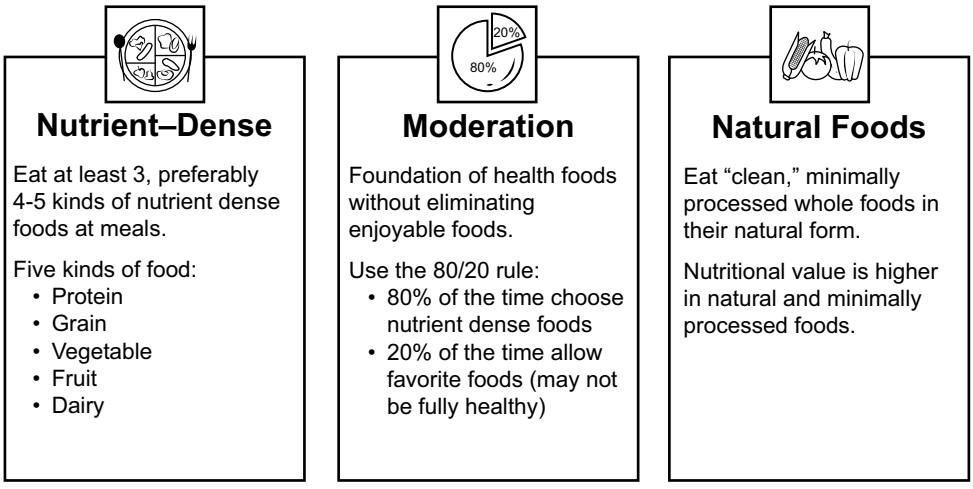

Figure 2-6. Guidance to Help Create a Balanced Diet to Fuel Marines.

Nutrient Intake by Exercise Phase. During each training phase, nutrition requirements change. Refer below to determine the macronutrients needed during each phase based on a Marine's daily intake:

- *Hypertrophy*: the recommended average intake is 30 to 40 percent carbohydrates, 20 to 30 percent fats, and 20 to 30 percent proteins.
- *Strength*: the recommended average intake is about 40 percent carbohydrates, 30 percent fats, and 30 percent proteins.
- *Power*: the recommended average intake is 50 to 55 percent carbohydrates, 30 to 40 percent fats, and 20 to 30 percent protein.
- *Endurance*: the recommended average intake is 55 to 65 percent carbohydrates, 25 to 35 percent fats, and 15 to 25 percent protein.

Plan Ahead. Every Marine has unique needs based on their body. Marines should—

- Know their body tolerances (e.g., food preferences, allergies, or stomach sensitivity during activity). Experiment during training and before missions.
- If needed, use caffeine (up to 200 milligrams) 30-60 minutes before activity to increase alertness and focus.
- Know calorie needs and eat at regular intervals.
- During multiple hours of high-intensity physical activity, snack regularly with a goal of consuming 60 to 90 grams of carbohydrates per hour.

Phases of Timing. "When" Marines should consume nutrients is just as critical as "what" nutrients are consumed. Timing of nutrients should be viewed as three distinct phases: pre-activity, during activity, and post-activity (see Table 2-8).

Table 2-8. Activity Fuel and Ingestion Timing.

Activity Timing	Purpose	Carbohydrates	Protein	Examples
Pre-activity	Provide energy for light, moderate, or high-intensity exercise.	30 to 60 minutes prior 200 to 300 calories	Up to 25 grams for strength training.	• Bananas • Oats • Greek yogurt • Avocado • Almonds or walnuts
During activity	Energy stores are used and protein in the muscle breaks down.	< 60 minutes: water > 60 minutes: 30 to 60 grams per hour or 7 to 20 grams every 15 to 20 minutes in liquid form > 3 hours: 110 grams per hour in solid and liquid form	Consumption during activity has no benefit.	• Sports drinks • Coconut water • Sports gels, bars, or chews • Fresh or dried fruits • Pretzels
Post-activity	Restore depleted energy and promote recovery no later than 60 minutes after activity.	50 grams within 60 minutes after exercise 100 to 150 grams every two hours, up to six hours	Consume foods with essential amino acids for muscle repair and insulin regulation. Up to 40 grams based on the type of training.	• Eggs • Dairy • Chicken • Fruit • Grains (whole grain bread, etc.) • Carbohydrates-to-protein ratio equals 2:1 (e.g., 50 grams carbohydrates, + 25 grams protein)

Success in fueling for performance means keeping it simple. Here are four keys to success when planning for physical activity:

- Avoid foods extremely high in fat or fiber to reduce gastrointestinal (stomach and digestion) issues.
- Try different foods before and during regular training to determine what works best for the body, but do not experiment right before or on an event day or mission.
- Up to 200 milligrams of caffeine (e.g., a 16 ounce coffee), 30 to 60 minutes before an endurance activity can improve performance, but intake should be closely monitored, and adequate water consumption should accompany it.
- Recovery is dependent on food choices throughout the day, so make smart decisions.

Table 2-9 can help Marines plan energy and fluid intake needs based on bodyweight for before, during, and after missions.

Table 2-9. Mission Energy and Fluid Intake Based on Weight.

BODYWEIGHT (LBS.)	TIMING		
	Pre-Mission	During**	Post-Mission
<145 to 165	80-300 grams of carbohydrate; drink to relieve thirst	• 30-60 grams of carbohydrates per hour. • 16-32 ounces per hour.	• 80 to 120 grams of carbohydrates. • 15-25 grams of a protein drink to relieve thirst and promote urine production.*
165 to 185	90-350 grams of carbohydrates; drink to relieve thirst	• 30-60 grams of carbohydrates per hour. • 16-32 ounces per hour.	• 80 to120 grams of carbohydrates. • 15-25 grams of a protein drink to relieve thirst and promote urine production.*
>185	100-400 grams of carbohydrates; drink to relieve thirst	• 30-60 grams of carbohydrates per hour. • 16-32 ounces per hour.	• 80 to 120 grams of carbohydrates. • 15 to 25 grams of protein drink to relieve thirst and promote urine production.*
NOTE * Fluid needs vary by individual; do not exceed 1.5 quart per hour. ** Cold weather or high-altitude increases requirement to 50-75 grams of carbohydrates per hour.			

Hydration

Water is essential to all body functions and performance, but an individual's requirements for water intake varies. This need is based on diet, body type, health status, and intensity of physical activity. Military guidelines recommend 96 to 144 fluid ounces per day for men and 64 to 96 ounces per day for women. As a general rule, consume half of the bodyweight (in pounds) in fluid ounces daily. For example, an individual who weighs 200 pounds would need approximately 100 ounces of water per day. Remember that all fluids from food and beverages count towards this goal. Fresh fruits and vegetables contain high amounts of water, such as in broccoli, tomatoes, watermelon, and peaches.

Fluid balance is the amount of fluid ingested versus the amount of fluid lost, mainly through sweating and breathing. Be sure to adjust intake when training or exercising outdoors, especially when it's hot and humid. If it is very hot, drink fluids with sodium and potassium (e.g., sports drinks) to replace electrolytes lost from sweating. When less fluid is ingested than excreted, this fluid loss can cause dehydration and other heat illness which decreases physical performance.

To help maintain hydration, consume foods and fluid-replacement beverages that contain electrolytes before, during, and after high-intensity training or exercise. Marines who eat at a mess hall can look for the Stoplight System signs from the Fuel to Fight® program to make informed decisions about electrolyte replacement.

Monitoring Hydration Status. Monitoring hydration status is essential to prevent heat illness, increase physical and mental ability, and promote healing in the body after intense exercise. Water provides the body a pathway for its essential functions. There are two recommended ways to monitor hydration status: urine color, and bodyweight.

Bodyweight. Bodyweight is the estimated weight before and after activity: total bodyweight (before), subtracted by total bodyweight (after), equals total fluid lost during exercise.

As little as two percent loss of bodyweight poses a threat to performance, and greater than three percent loss indicates an individual is at higher risk of heat-related illness and dehydration. Also, an individual's daily water intake requirement is, approximately 16 to 24 ounces, and it should be consumed per pound lost in bodyweight.

Urine Color. Urine color can be used to assess hydration status. Pale yellow, almost clear urine indicates adequate hydration. In general, the darker the urine, the more dehydrated one is. It's important to keep in mind that urine color can change regardless of hydration status. For example, vitamin B supplements (particularly ones high in riboflavin) can make urine neon-yellow colored.

How often an individual urinates can also provide information on hydration status. The less fluid that is ingested, the less often an individual will have to urinate, and an individual can be dehydrated. Frequency can vary due to other factors such as the bladder size, pelvic floor health, and other medical conditions such as a urinary tract infection.

Marines must be well-hydrated before exercise to minimize dehydration during or after exercise. Marines should limit fluid intake to one to approximately 48 ounces per hour during exercise, with a "gulp" being about one to two ounces. Although these are general recommendations, Marines still need to monitor their fluid loss.

Alcohol, Tobacco, and Nicotine

Alcohol, tobacco, and nicotine consumption is a modifiable and intrinsic risk factor. It is detrimental to recovery and performance and can cause dehydration. Marine Corps Community Services provides programs and education to help Marines quit tobacco and nicotine use. The following risks can increase when Marines consume alcohol, nicotine, or tobacco:

- Being under the influence of alcohol while physically training negatively affects coordination, mental focus, risking injury and overall physical performance.
- A hangover from excessive drinking can negatively affect physical and mental performance, which can lead to injury during physical activity and cause dehydration.
- A hangover can also increase caloric intake with no energy benefit and cause other symptoms such as nausea, vomiting, and headache.
- Cigarettes, smokeless tobacco, e-cigarettes, and vapes inhibit cardiorespiratory performance and affects recovery from exercise and injury.

- Blood flow decreases and oxygen delivery from using tobacco use slows the body's healing process.
- Nicotine and tobacco use can increase existing pain.

Supplements and Ergogenic Aids

Marines should do their best to obtain optimal nutrition through food sources, but they might need to use dietary supplements with guidance from a healthcare provider. Many service members use dietary supplements to improve health, and performance while bodybuilding, to lose weight, and or other reasons. Dietary supplements can cause undesired effects and compromise total fitness. Some of the most common dietary supplements Marines use are—

- *Protein:* taken to aid in the growth and recovery of muscle fibers after intense physical activity.
- *Creatine*: (in theory) increases power and strength during physical activity.
- *Pre-workout supplements*: increase energy and, in theory, enhance strength and endurance but can have negative side effects, such as heart palpitations and dehydration.
- *Branch Chain Amino Acids*: (in theory) enhance muscle growth and performance.
- *Multi-vitamins*: daily supplement to help enhance nutrients in a diet for general health and wellness.
- *Vitamin C*: often used to boost the immune system, but the body only absorbs up to a certain amount each day.
- *Melatonin:* a natural supplement that helps create a relaxed state or sleepiness.
- *Fish oil*: (in theory) has anti-inflammatory effects that could help with physical recovery.
- *Caffeine*: Up to 200 milligrams of caffeine 30 to 60 minutes before an endurance activity can improve performance, but Marines should monitor intake and consume enough water to stay hydrated. Considerations include—
  - Pre-and post-workout products often contain caffeine or other stimulants and can cause sleep disturbances when consumed too close to bedtime.
  - Energy drinks that contain caffeine and guarana, when consumed in excess, can pose a health risk; this includes irregular heart rhythm, increased blood pressure, and decreased sleep quality.

A Marine should consult a medical professional before introducing any dietary supplements into their physical fitness program and health routine. Personnel such as physicians, registered dieticians, and athletic trainers can inform a Marine on the benefits and risks based on the best-available scientific evidence.

Operation Supplement Safety. Operation Supplement Safety is a mission designed to provide the best evidence-based information about dietary supplements to service members, their families, healthcare providers, and leaders to achieve human performance optimization. Unfortunately, some supplements can compromise rather than improve performance. The goal of this program is to provide the tools and resources to help the individual make informed decisions about dietary supplements to optimize their health, performance, and career. For more information and guidance on dietary supplements Marines should refer to DoD Instruction 6130.06, *Use of Dietary Supplements in the DoD*.

SLEEP HEALTH

Sleep habits are modifiable and intrinsic factors largely influenced by the thoughts, perceptions, and attitudes towards sleep. The four basic sleep pillars are quality, regularity, quantity, and continuity. Each pillar is interrelated, so it is important for Marines to consider the pillars as a whole when evaluating and optimizing sleep. An imbalance of one or more pillars can increase a Marine's risk of injury and adversely affect health—

- *Quality*: how restful and restorative sleep is.
- *Regularity:* consistently going to sleep and waking up at the same time, including weekends.
- *Quantity:* the amount of sleep.
- *Continuity:* the amount and distribution of sleep versus that of wakefulness in each sleep period (e.g., the number of times one wakes up in the night or the ability to remain asleep).

Sleep Optimization

Sleep optimization follows a hierarchical structure. The most important factors are behaviors influenced by thoughts, perceptions, and attitudes about sleep. Research has found that positive thoughts, perceptions, and attitudes about sleep are closely associated with longer sleep duration and better sleep quality. Circadian rhythm entrainment (synchronizing the biological clock to external cues) is the second most important factor and includes light and darkness, sleep and wake timing, nutrition and exercise timing, and temperature. Stress management is the third most important factor and includes breathing patterns, stress load and mitigation, endurance (aerobic and strength), and mindfulness. The fourth, and most important factor is lifestyle, which includes nutrition considerations, substances and supplements, and presence of technology (music and electronic screens).

Strategies for Sleep Optimization. There are several strategies for improving sleep quality. These influences also determine physical fitness status, which is positively correlated with sleep optimization. If sleep optimization is poor, physical fitness also suffers. Table 2-10 provides various optimization strategies to improve sleep.

Table 2-10. Sleep Optimization Strategies.

Behavior Strategies	Circadian Rhythm Entertainment	Stress Management	Lifestyle (Sleep Hygiene)
• Debunk sleep myths and misconceptions • Journal • Control stimuli • Prioritize sleep • Set sleep goals • Keep a sleep log • Adjust routines	• Exposure to early morning light • Use blue light blocking glasses or screens • Regular sleep and wake times within 30 minutes • Time restricted eating • Maintain times for physical training and movement • Raise thermostat when walking and decrease for sleeping	• Breathwork • Meditation • Address stressors (including perceived) • Exercise • Practice yoga or Tai Chi • Spend time outside	• Optimize nutrition • Keep a food log • Avoid caffeine six hours before sleep • Avoid alcohol four hours before sleep • Avoid nicotine two hours before sleep • Make sleeping area comfortable • Remove all technology and screens from the sleeping area

Recognizing Consequences of Poor Sleep Health. Failure to get enough sleep can causes more than feeling tired and fatigue. Sleep deprivation can affect individuals differently, but there are negative consequences that can infiltrate an individual's personal and work life. Inadequate sleep, compounded over time, can decrease physical fitness; Marines who lack sleep have a harder time improving their fitness levels. Negative consequences include the following:

- Decreased reaction time and endurance.
- Increased risk of injury and illness.
- Weight gain (increases in poor food choices due to physical hunger cues and lack of energy to exercise).
- Long-term health problems (high blood pressure, diabetes, and heart disease).
- Increased irritability and stress levels.
- Increased impulsive behavior (leading to mistakes).
- Decreased mental acuity (ability to make good decisions and focus).

Marines train to extreme tiredness and fatigue to prepare as a warfighter, but when Marines can attain proper sleep, they should do so to ensure they are ready when the time comes to complete the mission. Poor sleep health can not only negatively affect the individual, but also those around them.

CHAPTER 3.
CHALLENGES AFFECTING PHYSICAL FITNESS

Although there are many benefits to being a United States Marine, the title also comes with its unique and often demanding set of challenges. Their foundational training enables Marines to face challenges head-on, but preparation for, and resiliency in the face of, these challenges require peak levels of physical fitness.

LOW LEVELS OF PHYSICAL FITNESS

Marines operate as a unit; however, each individual has different needs and abilities. Meeting those needs calls for various physical fitness levels. Whether they are entering their first year, or have over 20 years of service, Marines must meet annual physical standards by completing the PFT and CFT. Marines who have low physical fitness levels can keep fellow Marines from reaching basic requirements and physically fail during long field operations. It also puts them at risk of injury or even medical separation.

Low physical fitness levels can occur in individuals who do not prepare before entering the Marine Corps. Underestimating the Marine Corps' physical demands before entering a Marine Corps Recruit Depot, Officer Candidate School, or The Basic School puts an individual at a disadvantage. This can lead to a game of catch-up that can carry over to other formal learning centers.

Injury, illness, and other life situations (e.g., the birth of a child or family crisis) can also lead to decreased levels of physical fitness if it interrupts their training program for an extended period. This can lead to the deconditioning of all physical fitness components. Marines must take accountability within their training to maintain optimal physical fitness levels. For more about how to maintain or regain physical fitness while injured, read the Injury and Illness section later in this chapter.

TRAINING PLATEAUS

Training plateaus can happen to the most fit Marine because, physical fitness programs should not be 'one size fits all.' A training plateau is a period when an individual does not see improvement despite their commitment to training. For example, even with consistent training to improve their three-mile time, it stays within the same five seconds, or a one-repetition max squat capability does not advance in weight.

Training plateaus can happen for various reasons, such as—

- The body is not required to adapt to new stressors.
- Consistency, motivation, and effort decrease gradually over time.
- Exercise times or distances do not progress properly, or at all.
- Exercises and training (e.g., emphasis on fundamental movements) do not vary.
- Insufficient nutrition, calorie intake, and hydration.
- Inadequate recovery and sleep.

Improving Physical Fitness Levels

Regardless of the reason, physical fitness levels decreasing or becoming stagnant is frustrating and can affect a Marine's performance. Improving physical fitness levels is a mix of commitment, logical progression, and functional exercises. Goal setting (refer to Chapter 1) is a great tool to build commitment and accountability to a physical fitness program.

Physical Training Technology. The Marine Corps has developed mobile applications with the expertise of FFIs, strength coaches, and athletic trainers to motivate and help Marines maintain a healthy physical fitness program and maintain good health. Programs are developed according to the Marine Corps Physical Fitness Program, which is designed to use the latest scientifically based techniques and modern technology in the sports medicine field. These applications are intended to help any Marines meet their goals and provide a safe progression through a physical fitness program that focuses on keeping variety and functions.

Semper Fit: Strength and Conditioning. The Semper Fit strength and conditioning program is a combat-focused strength and conditioning program specifically geared to Marines. It provides individual and unit resources designed to make Marines combat-fit-ready. The Semper Fit strength and conditioning program is endorsed by the National Strength and Conditioning Association's Tactical Strength and Conditioning Department. This program provides variety and introduces functional training into physical fitness plans.

Force fitness instructors write programs and run workouts. Commanders and small-unit leaders can ask a strength and conditioning coordinator about support for their unit that meets their physical training and competitive needs. This type of training can prepare a Marine to withstand the harsh physical demands of being in the field.

NUTRITION KNOWLEDGE

Creating a meal plan with a balanced diet can be overwhelming. The Marine Corps has implemented a meal-planning program intended to provide Marines nutrition education through a color system. Assigning green "Engage at Will," yellow "Well-Aimed Shots," or red "Check Fire" designations (see Figure 3-1) requires Marines to examine foods for additives, degree of processing, and nutrient values.

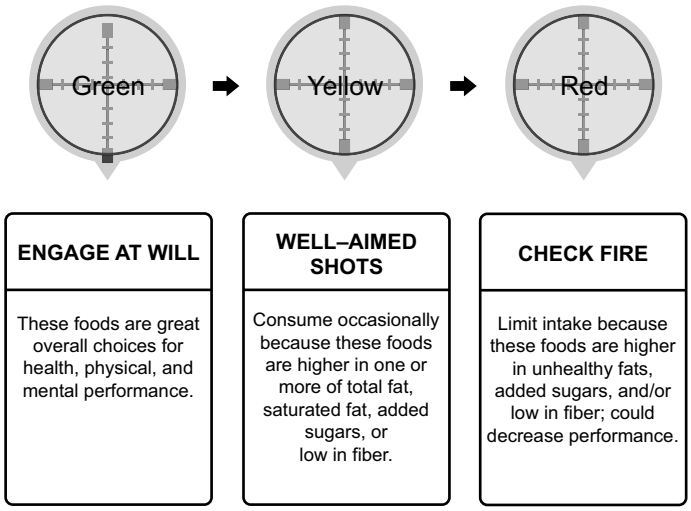

Figure 3-1. Meal Selection Color Designations.

Menu items in the mess halls are color-coded so Marines can make healthy choices. The easy-to-use system provides identifiable choices; it does not eliminate options.

Environmental Adaptations

Every environment has unique hydration needs. Marines and unit leaders should monitor fluid intake because being properly hydrated leads to effectively conducting tasks. Two environmental extremes are—

- *Hot Environments*: the body requires more calories to produce enough energy and drinking more fluids makes up for sweat loss.
- *Cold Environments:* the body requires an increase in carbohydrates and caloric intake to help produce energy to keep the body warm, while paying attention to hydration levels when thirst may not be a reliable indicator.

One canteen equals 32 fluid ounces, whereas hydration bladder capacities vary (64 to 128 fluid ounces). During physical activity, the goal should always be to replace the fluid that is lost from sweat in addition to the established daily fluid requirement.

Table 3-1 describes hydration needs and recommendations based on the environment.

Hypobaric Nutrition

High-altitude environments, such as the mountain warfare training center region, have been shown to cause weight loss. Two main causes of weight loss at high altitudes are a suppressed appetite that decreases calories consumed, and an increase in basal metabolic rate. With an increase in basal metabolic rate, the body requires more calories than usual to maintain life-sustaining functions at rest (this does not include increased energy demands for physical activity and operations). Marines who perform the same training or physical job tasks in the cold as they did in warmer environments without increasing calories would likely experience decreased energy and weight loss because their bodies are operating with less fuel. Additionally, because in

such scenarios the body typically takes the energy it needs from muscle rather than fat, those with a low body fat percentage might experience muscle atrophy, which can inhibit a Marine's ability to perform job-related tasks safely.

Table 3-1. Hydration Chart.

Environment	Consideration	Hydration Recommendation
Dry Heat	The extreme dry heat greatly increases the risk of dehydration and heat injury. Chemical, biological, radiological, and nuclear protective equipment increases fluid needs.	Suggested intake: 64 to 160 fluid ounces per day. Tips: Marines can reduce sweat rates by working out at night. During daylight hours, cover the skin with light, vapor-permeable clothing. Drink cold water and sports drinks.
Hot and Humid	Relative humidity can increase a body's water requirement needs. Humidity makes sweat evaporation difficult and decreases the body's ability to cool down.	Suggested intake: up to two times the fluid amounts a body needs when it is exposed to extreme dry heat. Tips: Drink cold water and sports drinks.
High Altitude	More fluid than typical is lost through urine output and breathing. Layered clothing can cause increased sweating in Marines with little evaporation (creating dampness).	Suggested intake: 64 to 160 fluid ounces per day. Tips: Drinking small quantities of fluid frequently results in less urine production than drinking large quantities less frequently.
High Altitude and Cold	Adding cold to altitude can cause a greater risk of dehydration because of sweat loss due to insulated clothing, low rates of fluid consumption, and unwillingness to take clothing off to urinate.	Suggested intake: 96 to 192 fluid ounces per day. Tips: Marines should consider clothing ventilation to allow heat to escape and decrease sweat loss. Drink small quantities of fluid frequently and consume hot fluids and broths.

Those working at high altitudes must also consider the potential for extreme temperature changes. For example, Marines could be sweating one minute because of strenuous work in heavy clothing and shivering the next when they stop to take a break. Fluid loss in a cold or high-altitude environment should not be underestimated. A Marine should not rely on thirst as an indicator to hydrate. This, combined with environmental factors can lead to under-fueling (not eating enough calories). Under-fueling is influenced by a decrease in appetite and thirst, but also decreased access to portable water, making field rations harder to prepare.

To maintain physical fitness at altitude, Marines at high altitudes should consume approximately two times the calories as they do at sea level. Setting up a schedule to eat, following it even when not hungry, and focusing on carbohydrate-rich foods and beverages can prevent decreases in mental and physical performance. Although in the field, a Marine's food choices are limited to prepared field rations, it is recommended Marines pack calorie-dense snacks (if possible). Nutritional deficits do not typically come from eating the "wrong" foods, but from not eating enough food. The recommended daily caloric intake is approximately 50 percent carbohydrates and approximately 35 percent fat.

SHIFT WORK AND TIME MANAGEMENT

Shift work includes evening, night, and early morning shifts, as well as fixed or rotating schedules (i.e., any work schedule that falls outside of 0700 and 1800). Shift work can take a toll on a body's circadian rhythm and can cause sleep problems. The strategies in Figure 3-2 can be used to decrease sleep-wake cycle disruptions and mishaps.

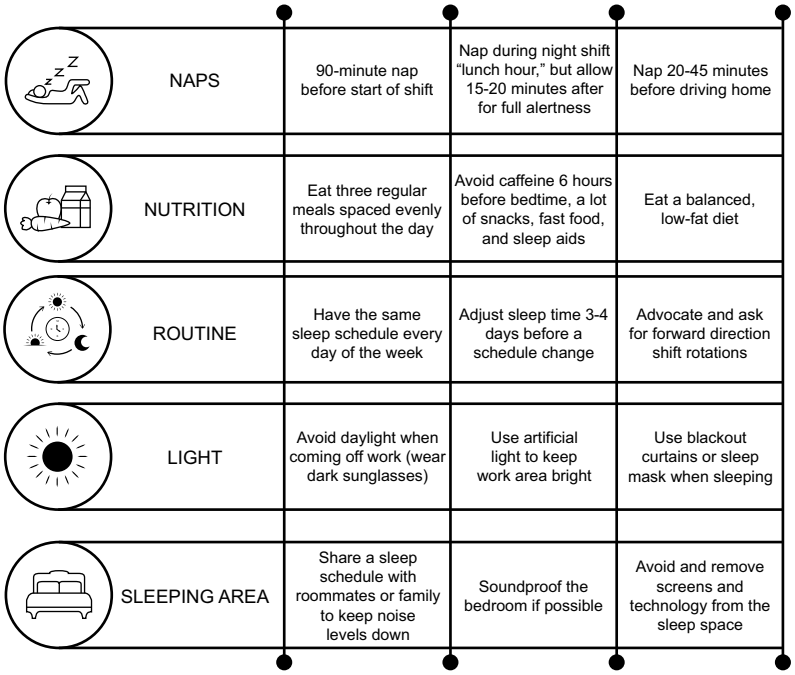

Figure 3-2. Strategies to Optimize Sleep on a Shift or Night Work Schedule.

CAFFEINE

About 200 milligrams of caffeine (equivalent to two eight-ounce cups of coffee or one energy drink) is enough to help decrease feelings of sleepiness and fatigue but should be adjusted based on the individual's sensitivity to caffeine. If consuming caffeine causes shakiness and quickens the heart rate too much, that individual should consume less caffeine. Caffeine can help decrease sleepiness and fatigue but is ultimately not a substitute for sleep as it does not restore judgment, coordination, cognitive ability, or reaction time.

TRAVEL

The mental and physical stress associated with travel can lead to sleep disruptions. Jet lag, especially when crossing over three or more time zones can lead to even greater disruptions. Individuals traveling eastward can experience possible jet lag. Planning is key to a successful trip: decrease stress by printing out and downloading tickets and itineraries before traveling, as well as gathering all travel documents in one place. Cleaning and organizing before traveling can also decrease an individual's stress level upon returning home and allow for optimal rest.

Marines should avoid packing at the last minute and include the following on their packing list:

- Lightweight exercise equipment (e.g., resistance bands).
- Headphones or earplugs.
- Travel-size white noise machine or white noise phone application.
- Neck pillow and small travel blanket.
- Healthy snacks.
- Sleeping bag liner, to avoid scratchy sheets.

When Marines arrive at their destination, setting up the sleeping area should be a priority to establish quick sleep routines, and optimizing sleep. This might include removing extra bedding, locating, or requesting missing bedding, closing windows and doors, and clipping gaps in any curtains closed.

Avoiding jet lag may be unrealistic depending on the distance to the destination. Jet lag is the time the body's circadian rhythm takes to adjust to a new time zone. Figure 3-3 provides simple strategies for keeping this jet lag time as short as possible.

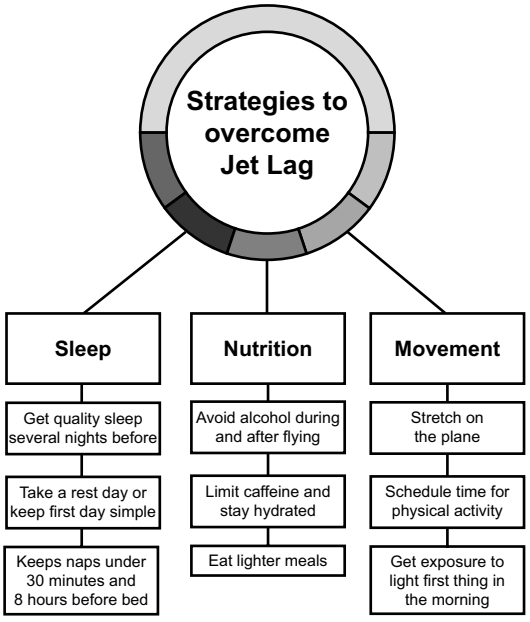

Figure 3-3. Strategies to Manage and Overcome Effects of Jet Lag During Travel.

HARDSHIPS IN THE FIELD

Marines are often required to spend days or months in the field without regular comforts or their home routine. In situations where resources are not being replenished, the focus turns to survival. This is different from a simulated training scenario, which is meant to be controlled and safe. A strong foundation of physical fitness can help the Marine's body survive the physical effects of sleep loss, physical fatigue, and hunger.

Preparation is sometimes a luxury for Marines who can be sent on a mission with little notice. By maintaining peak physical fitness, a Marine can control their routine and actions, which prepares them for a mission.

Deployment, Missions, and Permanent Change of Station

Deployment and a permanent change of station (PCS) can cause uncertainty for Marines, their families, and other support. Each situation has challenges that can easily disrupt an established physical fitness plan. During deployment or a PCS move, Marines can temporarily lose their routine, exercise equipment, and support.

Sleep Before and During Deployment and Missions. When sleep is consistently restricted, Marines adapt, but at a reduced level of alertness. Research says there is no evidence that the body can completely adapt to inadequate sleep. Prior to deployment or a mission, a Marine should aim to get seven or more hours of sleep a night and avoid caffeine or alcohol six hours (nicotine two hours) before going to sleep. While deployed or on a mission, naps are recommended (whenever a Marine can find the time and safe area) to help increase sleep to a total of seven hours during a 24-hour period.

If sleep or a nap is not possible, rest breaks (without sleep) and time off-task can help sustain performance but does not remove the risk of decreased alertness and physical capability. This is especially important for Marines conducting tasks that not only require physical effort, but mental energy as well.

Environment Changes. A dramatic change in environment can occur during deployment or a PCS. For example, a Marine stationed in Virginia who moves to Okinawa, Japan, changes from a place that experiences all four seasons to a tropical location. This can affect the time of day a Marine exercises. Those who like to exercise in the afternoon, might find it too hot or humid; a schedule change could further affect their physical fitness habits.

INJURY AND ILLNESS

A Marine should take preventive measures to minimize an injury or illness. Most injuries are preventable when Marines establish a well-rounded physical fitness program. Yet even the most prepared Marine could still experience an injury or illness outside their control. The severity of injury and illness can vary, but they can all have negative effects on a physical fitness routine.

While experiencing an injury or illness, Marines could still incorporate a low-intensity activity in place of their routine. Injured and ill Marines should seek assistance from qualified personnel such as an athletic trainer or an FFI.

Pain

Pain accompanies most injuries and some illnesses, but its effects can vary based on an individual's pain tolerance and its severity. Pain can keep even the most resilient Marine from following a physical fitness program. The presence of pain is a signal that something is not right in the body and it must be addressed. This is not to be confused with muscle soreness, as that is a common symptom of intense exercise and should resolve within two to three days.

To self-assess pain and help determine what is abnormal, refer to Chapter 2. Non-traditional exercise can also help manage pain while finding an alternative approach to maintaining physical fitness. This can include activities such as yoga or Tai Chi, which help improve muscular strength and endurance, flexibility and mobility, and balance and proprioception.

During a mission, Marines might find themselves having to endure pain ranging from minor to severe. Being physically fit helps keep one's body from breaking down quickly during stressful and physically demanding situations. Good nutrition helps the body store and employ agents that are responsible for healing injury and illness. Finally, implementing proper breathing techniques can help Marines improve and maintain their focus on mission success.

Deconditioning

When Marines experience time away from their physical fitness programs, it can cause deconditioning or loss of physical ability and capacity that Marines built up during exercise. Tolerance for time, distance, and load can decrease when the body is not being trained. Deconditioning can affect each fundamental component of physical fitness and Marines need to re-train the body to get back to their desired physical fitness level. When restoring a training regimen, it is important to maintain a safe and logical progression, because attempting too much too soon significantly increases one's risk for injury. Marines should take the following steps when re-starting a physical fitness program:

1. Create new SMART Goals (see Chapter 1).
2. Work with qualified personnel (athletic trainers, FFIs, etc.) to create a routine.
3. Be mindful of RPE and pain levels and adjust intensity accordingly.
4. Access additional resources to help make a well-rounded program.

Body Composition

During deconditioning physical activity levels might diminish. A Marine's body composition can be affected if caloric intake does not reflect the level of physical activity being conducted. Body composition changes can include weight gain, and if a Marine is not within the height and weight requirements additional steps might be taken to ensure ideal health, wellness, and military appearance. Although some weight variation can be healthy, targeted weight gain and loss should always be pursued under the guidance of qualified personnel (e.g., physician or registered dietician).

Maintaining optimal physical fitness also means maintaining healthy nutrition. There are resources available to help create a plan and understand how food can best fuel the body. Compare the body to a luxury car, which needs a specific type of fuel. Putting the wrong type of fuel in this car can ruin the engine; additionally, if fuel is not put in the car at all, it cannot even run.

Food is fuel for the body. Nutrient-dense foods help the body function properly and keep its systems healthy. Consuming food also helps the body do the physical tasks it is being asked to complete. For example, when preparing for a long-distance hike, eating an initial meal and snacks throughout the hike provide muscles with the fuel to keep working. Figuring out what, when, and how much to eat can be complicated, and a Marine should experiment with when and how much food is needed during physical training sessions.

Dangerous Practices

Attaining physical fitness takes time, patience, and persistence. Marines strive to meet high standards and expectations, but they should not forget about the human body's limitations. There are no shortcuts. Some Marines might be persuaded to participate in dangerous practices to meet body composition standards or improve job performance. The desire for instant success leads to taking shortcuts and choosing to participate in dangerous practices.

Under-Fueling and Malnutrition. A Marine must create and stick to a nutritious meal plan following the 80/20-rule recommendations (see Chapter 3). When the body does not receive enough calories to sustain life functions (breathing, heartbeat, etc.) and support physical demands placed upon it, a calorie deficit occurs. This calorie deficit forces the body to find energy from other sources within the body. If stored energy sources (e.g., fat) are not available, the body begins to break down muscle tissue. This leads to chronic pain and injuries that are hard to recover from.

Under-fueling can also lead to malnutrition, or not consuming enough macro- and micro- nutrients (see Chapter 3) to keep the body healthy. Chronic injuries from under-fueling are caused by not giving the body the nutrients it needs to heal, which creates a vicious cycle of injury and pain. Malnutrition can also present with other physical symptoms such as chronic fatigue, changes in hair, nails, and skin, and a decline in mental health. These negative consequences of under-fueling for one Marine can compromise the safety of the mission and team.

Exercise Addiction and Over-Exercising. Exercise addiction takes over-exercising to an obsessive level. This addiction also negatively interferes with a Marine's work and the quality of life by taking time away from other obligations, causing them to withdraw from others, and causing pain and injury. It interferes with a Marine's ability to be physically resilient.

A Marine's physical fitness plans should be all-encompassing and reflective of the physical demands of their duties. Rest and recovery are key components of a physical fitness plan, as they give the body time to recover and repair. Over-exercising can also be called "burnout" or "overtraining." When the body experiences too much stress, it can no longer withstand the load it is being given. For example, a Marine's focus on improving their PFT pull-up number could lead to them performing too many overhead lifting exercises. At some point the muscles in the shoulder would become inflamed and tear, causing chronic shoulder pain and injury. Despite good intentions to improve the number of pull-ups, they are instead out on LIMDU, or worse, unable to effectively perform operational tasks.

Rapid Weight Loss Methods. Everyone has different needs and requirements for maintaining a healthy weight. What works for one person may not work for another. To lose, maintain, or gain weight in a healthy manner, Marines should consult with a qualified professional, such as a registered dietician or physician and create a safe plan for achieving these goals. The desire to quickly lose weight can lead to under-fueling, malnutrition, and overexercising, which greatly increase the risk of physical and mental injury and interfere with a Marine's ability to be lethal and resilient.

Disordered Eating and Eating Disorders. Individuals may experience the pressure to drop weight quickly to achieve certain standards, but altering eating habits can be a dangerous "solution." Disordered eating is abnormal eating habits and behaviors (i.e., dieting, fasting, or purging) that

do not clinically call for an eating disorder diagnosis. They can still be dangerous because they can lead to malnutrition. A disordered eating example would be participating in fad diets that cut out a main food group. Without consulting or a qualified professional, a Marine should be wary of making dramatic changes to a well-balanced diet.

Eating disorders are clinically diagnosed illnesses that affect an individual's eating habits that can be driven by addiction, such as characteristics that create a negative relationship with food. Common eating disorders include binge eating, bulimia nervosa, and anorexia nervosa. They can occur with or lead to mental illness and can even be fatal. Men and women are both susceptible to eating disorders.

The Influence of Social Media. Social media floods the internet with positive and negative influences, especially when it comes to physical fitness. It exists in many forms including popular social networking sites, media and video-creating platforms, and online video gaming. Even if a Marine does not use social media, people they interact with might, and online information can still be obtained and distributed. Anyone (qualified and unqualified) can distribute information to millions of people. Marines must be diligent, critical thinkers, and arm themselves with knowledge to determine whether advice is valid or not.

Social media can become a negative influence at work and in life through constant notifications and distractions, disrupted sleep, and even physical pain and discomfort due to poor posture and eye strain. Not only can overusing social media take away vital time to sleep, but it can also take time away from exercising, preparing and eating a nutritious diet, and spending time with loved ones. As with many life choices, moderation is key. Social media use should not be a Marine's priority, as it can contribute to a sedentary lifestyle.

CONSIDERATIONS FOR THE FEMALE MARINE

The foundations of physical fitness are the same for all Marines. What differs is how the female body responds to exercise as compared to a male. For decades, research on physical fitness and its effects has been primarily conducted on male subjects because of the decreased number of variables to be observed. This has led to a severe lack of scientific evidence on how exercise and female physiology influence each other. Research addressing the female body is expanding (e.g. such as a hormone cycle that changes both monthly and throughout a lifetime). Certain considerations should be made when building a physical fitness program for female Marines so they can achieve the same success.

Menstrual Cycle Phases and Physical Activity

An average menstrual cycle is 28 days, with day one being the first day of menstruation. Women experience cycles that can sometimes vary between 7 to 14 days. Abnormal cycle patterns make it difficult to build a physical fitness program tailored to everyone's needs, but recognizing physical signs and symptoms can help female Marines adapt their existing programs to achieve the most effective outcomes.

For example, during ovulation (approximately two weeks before menstruation) estrogen hormone levels are at their highest. Estrogen can help improve muscular strength, so increasing weight or attempting one's maximum repetition during this time could result in higher performance results. Understanding how each menstrual cycle phase might or might not affect physical activity and response in the female body is complicated. Research has shown regular exercise prior to (and moderate activity during) the menstrual period can mitigate the pain for some women. The most important thing is for each female Marine to understand how her body feels and reacts and to adapt physical training to get the most benefit from times of energy and high activity.

Pregnancy and Postpartum

Pregnancy and postpartum cause significant changes in the body. Female Marines have unique needs during pregnancy and postpartum, requiring physical activities and operational responsibilities be modified. An established and well-rounded physical fitness program creates a foundation for a Marine to continue physical activity throughout pregnancy and post-partum. The Marine Corps provides guidance and policies for pregnant and post-partum Marines to help them maintain their physical fitness while adjusting their routines to stay safe. Refer to the *Pregnancy and Post-Partum Guidebook* for more guidance.

Menopause

Menopause is a stage in a woman's life that starts when regular menstruation cycles no longer occur. It can begin with a transition period called perimenopause, when cycles can become irregular and other symptoms such as hot flashes, night sweats, and sleep problems occur. Once menopause begins, there is an increased risk of osteoporosis (weakened of bones), which can lead to injury. Having an established physical fitness program and sticking to it is an important preventive measure before, during, and after menopause to keep the osteoporosis risk and weight gain low.

Bone Health

Female Marines have an increased risk of experiencing bone injuries compared to males because their bone mass is typically less dense. Every person has a maximum amount of bone mass they can gain (which peaks in their late 20s to early 30s). Loss of bone mass (osteopenia) is more common in women, specifically in post-breastfeeding and postmenopausal groups because of decreases in estrogen. Other factors that contribute to osteopenia risk include—

- Genetics.
- Abnormal or missing menstruation.
- Pregnancy.
- Low calcium and vitamin D.
- Eating disorders.

Decreases in bone mass can lead to stress reactions, stress fractures, and other injuries. Female Marines can monitor their bone mass using bioelectrical impedance devices that are available on every installation, and by requesting a basic blood panel during annual physicals that measure vitamin D and calcium levels to ensure their nutrition is sufficient to prevent bone loss. Maintaining a well-rounded physical fitness program with resistance and strength training can help maintain bone density.

Refer to Appendix A for more information on physical fitness resources.

CHAPTER 4.
TOTAL FITNESS DOMAIN INTEGRATION

The physical fitness domain makes up only a portion of the MCTF picture. A Marine's fitness in the mental, social, and spiritual domains must also be strong to maintain a holistic well-being and success. Each domain presents unique benefits and challenges for the physical fitness domain.

MENTAL FITNESS

Mental fitness refers to one's ability to integrate and optimize cognitive, emotional, and behavioral capacities to enable health and well-being, enhance individual and collective mission-essential task performance, and sustain operational readiness. It is having the ability to engage constructively in life, no matter what stress is encountered. This includes using tools and skills to mitigate, adapt to, and overcome the challenges and decision making in daily life and within the operational complexities of military service, and, when challenged, to access resources without fear. Higher levels of mental fitness are tied to advanced psychological resilience and overall good health and well-being. Emphasizing one's mental well-being optimizes their physical health. Having optimal physical fitness is crucial for fostering good physical brain health, but having good mental health is vital for optimizing performance and building resiliency.

Mental Fitness and Performance Optimization

Being physically fit enables a Marine to better respond to physical and mental stress. The best way to remain physically fit is to consume adequate, healthy nutrition; get optimal sleep; exercise regularly; and maintain healthy social connections. Experiencing an increase in physical and mental stress without allowing for proper adaptation and management can negatively affect a Marine's total fitness and lead to poor mental health. Poor mental fitness can lead to mental health disorders, can affect one's team and family, and can impair operations.

The nervous system allows the brain and body to communicate and coordinate. This is called cognition, or the coordination that allows people to think, learn, focus, solve problems, make decisions, plan, and control feelings and behaviors. The brain performs multiple functions at once, so when the body is not operating at peak physical performance, communication becomes interrupted. one who lacks good nutrition, adequate sleep, and exercise might experience impaired response times, as well as poor planning and coordination skills, memory and concentration loss, and loss of other high-level brain functions.

Physical and mental fitness go hand in hand in overcoming difficulties during tests such as the PFT. For some, a three-mile run is easy, but for others, it could be the longest distance they have ever run. A novice runner might start with the right mindset but needs to sustain it with a positive

attitude and behavior such as committing to a running plan that safely progresses in mileage each week. This practice demonstrates a good choice that fosters building resiliency to sustain one's physical abilities when challenging situations occur.

Another example of intrinsic factors includes Marines needing to make quick decisions under high-stress, typically when facing an enemy in an uncertain, continually evolving situation. By collaborating with others, Marines can help establish clear physical job responsibilities and increase the chances of success. Marines handle emotions by practicing positivity, setting realistic expectations, and functioning at an optimal-stress level to control their physical responses such as coordination, strength, and breathing, while maintaining a clear mind.

Mental Fitness Techniques and Skills

Poor physical fitness can negatively affect a Marine's mental fitness by decreasing their ability and confidence. Second guessing can lead to dangerous mistakes and increase the risk of injury to oneself and others. Having a strong body helps accomplish tasks such as passing the PFT and CFT, but it also contributes to strong mental fitness to help with positive coping in stressful situations. Table 4-1 provides multiple techniques and skills to help strengthen physical fitness through mental fitness. As with any physical task, with sufficient exposure and logical repetitions, Marines can improve these skills.

Table 4-1. Mental Fitness Techniques and Skills to Improve Physical Fitness.

Technique and Skill	Influence on Physical Fitness
Mental Rehearsal	Repeatedly running a scenario in the mind (imagery) increases the feelings of being prepared due to increased situation familiarity.
Progressive Muscle Relaxation	Marines can decrease the body's physical symptoms of stress (i.e., muscle tightness and soreness) by practicing muscle contraction and relaxation on command, while being in tuned with breathing; this improves the mind and body connection.
Mindfulness Meditation	Marines can use breathing techniques to calm the body and mind and focus on the present moment and train their minds to be attentive; using mindful meditation can be helpful during high-stress situations.
Tactical Breathing	Breathing to steady physical vitals (e.g., heart and respiration rates) and emotions, focus attention, and improve physical performance. This helps train the nervous system during stressful situations to prevent extreme physical responses.
Individual Zone of Optimal Functioning	The stress "sweet spot" allows a Marine to harness the right amount of energy required from the body's stress response to optimize physical and mental performance.
Building Habits	Establishing simple habits enables a Marine to perform physical actions while using little mental energy so the brain is available for more unfamiliar or demanding tasks (e.g., loading a rifle should be a rote process).

Traumatic Brain Injuries

Traumatic brain injury (TBI) diagnoses have increased due to advances in research, identification, and management. Improvements in protective equipment, battlefield healthcare, and medical evacuations have improved TBI outcomes. Experiences from war or accidents on the job can

cause TBIs (see Chapter 2). Traumatic brain injuries are not isolated to warfighting. They are common in people who have not been in combat, following events like sports-related injuries, physical training injuries, and vehicle accidents.

Research is proving that some centers in the brain can be damaged by a blast pressure wave or severe traumatic stress. Such physical damage to neurons in the brain tends to heal slowly. This means that the brain can experience physical and mental injury from a TBI. Physical and cognitive rest are needed to allow the brain time to heal so it can safely perform its physical and mental tasks. Severe TBIs can also cause people to experience decreased motor control, including coordination and strength, which makes movement and physical activity difficult.

Unreported, unresolved, or multiple TBIs can be detrimental to physical and mental health, both at the time of injury and in ensuing years. Complications from TBIs can include severe physical symptoms such as headaches and migraines, vision impairment, vertigo (intense dizziness), balance issues, nausea, and more. Cognitive function can also be severely affected. For example, lingering TBI symptoms and complications include memory loss, inability to form and retain new memories, slowed information processing and problem solving, and speech impairments. Ongoing research on TBIs indicates additional, long-term effects, which could include dementia-like symptoms, severe mood swings and emotions, and progressive brain tissue deterioration (breakdown).

Decline of Physical and Mental Fitness

There are numerous reasons one's mental fitness might decline, such as overtraining, routine life stress, mental illness, and more. In general, as physical fitness increases, mental fitness increases, but the same can be true for their decline. A decline in either physical or mental fitness affects a Marine's overall wellness. For most, a period of rest, resetting goals, or some stress management techniques helps a person recover. For some, a constant decline can lead to more serious mental health problems. Although no one is happy all the time, if depression, hopelessness, substance misuse, loss of appetite, sleep impairments, or suicidal thoughts persist, Marines should seek help.

A Marine can find help through various MCCS resources. Some help is completely confidential while other programs offer professional and peer support. If there is a medical emergency or someone is in immediate danger, call 9-1-1. Marines should use the following resources for more information and guidance:

- *Military OneSource*: This service provides various services including confidential crisis communication resources 24-hours a day, seven days a week (https://www.usmc-mccs.org/services/support/military-onesource/).
  - *Military and Family Life Counselors* (MFLCs): These counselors are on all installations and provide non-medical counseling onsite (https://www.militaryonesource.mil/non-medical-counseling/military-and-family-life-counseling/).
- *The Community Counseling Program*: This service equips Marines and families with the skills to address life's challenges before there is a significant effect on one's performance in their duties and relationships. It provides non-medical counseling but can also provide referrals to the appropriate healthcare professionals if needed (https://www.usmc-mccs.org/services/support/community-counseling/).
- *Suicide prevention services*: These services provide access to education, resources, and confidential care to help with suicidal thoughts, actions, or those at increased risk

(https://www.usmc-mccs.org/index.cfm/services/support/suicide-prevention/). For urgent situations call 9-1-1 or go to the nearest hospital's emergency department.

- Call 9-8-8 or dial 1-800-273-8255 and press 1 for the confidential and free Military Crisis Line.
- Chat online at militarycrisisline.net.
- Send a text message to 838255.
- In Korea or Japan call: 0808-555-118 or DSN 118.
- In Afghanistan call: 00-1-800-273-8255 or DSN 111.

- *Substance Abuse*: Reliance on painkillers following severe injury is a realistic threat. Marines might also use drugs or alcohol to cope with stress or past trauma. This program provides prevention services, education, and screenings for increased risk of substance abuse (https:www.usmc-mccs.org/index.cfm/services/support/substance-abuse/).

SOCIAL FITNESS

Social fitness is the ability to engage in productive personal and professional relationships, positively interact with unit and command networks, and leverage resources that promote overall well-being and optimal performance of mission-essential tasks. A strong social fitness foundation provides the motivation and accountability to improve and maintain physical fitness, especially during times of adversity. Being a Marine involves individual responsibility, but success is not achieved alone. Maintaining good personal and professional relationships increases resilience and mission success.

Effects on Physical Fitness

The effects social fitness has on overall health and physical fitness are important for performance optimization. It allows a Marine to assess, build, and optimize the relationships and interactions they have with others. Connections built around family, friends, teammates, and others in the community support mission success. These connections affect sleep health, nutrition choices, and recovery from injury, illness, stress, and trauma.

Good social fitness includes strong relationships and connections with friends, family, fellow Marines, and community members. Marines with these social ties can experience improved cardiorespiratory health, lower blood pressure, and less inflammation in the body. Those who are socially fit experience a shorter recovery time after an injury or illness and have a longer life expectancy than those who do not.

Physical Health and Relationships

People in an individual's life can influence their actions and emotions. Positive influences can improve behaviors, but negative influences can hurt their purpose. It is important to build healthy social relationships and be mindful of who makes up these relationships. Having people to care about, or caring about others, helps make healthy decisions easier. People who assume a responsibility to stay healthy for others or positively influence others in making good choices generally lead those individuals to better health. For example, a spouse supporting a Marine's nutritious diet at home or serving as a workout partner can help that Marine reach fitness goals.

Social pressures and norms can also contribute to good or bad choices. Having positive social norms can help a Marine stay on track to reach nutrition or physical goals. For example, a Marine would properly prepare for the PFT to meet the standard in front of peers. Adhering to negative social pressures can contribute to decreases in health. For example, joining a friend who wants to stay out late can compromise one's healthy sleep and make it difficult to perform job responsibilities the next day. It is important to keep and nurture those relationships that are positive influences. Fostering good relationships help individuals feel more in control of their environment. Feeling more in control of their environment helps reduce stress and increase motivation.

Positive personal and work relationships can help Marines stay focused, improve job performance, and have the emotional energy needed to perform job responsibilities. Marines can improve their social fitness by building team cohesion, trust, and interpersonal leadership skills. Social fitness strategies that help improve physical fitness are—

- *Support Networks*: family or community systems that are known and trusted increase resiliency and accountability; typical networks include sports teams, workout groups, or mentorships.
- *Sharing Knowledge, Skills, and Attitudes*: sharing perspectives, experiences, and advice can increase motivation and commitment. For example, a Marine who is good at running can help another improve their run time, or a Marine who knows about weightlifting can help another train to improve their upper body strength.
- *Cohesion*: Marines are much less likely to lose cognitive focus, or emotional and behavioral control when they are among trusted peers. This type of cohesion can lead to improvements in confidence and physical performance. For example, a Marine can promote social cohesion by starting or participating in physical training while off duty, such as a group run or a recreational sports team.

Social Barriers to Improving Physical Fitness

Having a stigma can negatively affect one's mental health, which can cause risk to one's physical health. The word stigma means "brand," or "mark." It decreases efficiency, damages families, and increases the risk of chronic health conditions. A social stigma can cause the individual to feel shame and denial and is inconsistent with the Marine Corps core values. Common consequences of social stigmas are—

- *Harm to Career*: health condition diagnosis can lead to trouble with career advancement or disqualification.
- *Intolerance of any Weakness*: judging others who are different based on physical, mental health, or fitness status.

SPIRITUAL FITNESS

Spiritual fitness results from incorporating personal faith, foundational values, and moral living acquired from various sources and traditions into one's nature and discipline. In doing so, Marines can live out the core values of honor, courage, and commitment, epitomize the warrior ethos, and exemplify the character expected of a United States Marine. Lacking spiritual fitness can

negatively affect motivation to improve or maintain their physical fitness. The ability to meet physical demands required of Marines can be related to one's values. Marines can positively affect their outer strength and performance by drawing on their inner strength. Read Marine Corps Reference Publication (MCRP) 6-10.1, *Spiritual Fitness Leader's Guide,* for more information and guidance about spiritual fitness.

Spirituality and Physical Fitness

Physical fitness is closely related to the mental and social fitness domains of the MCTF model. Belonging to a spiritual community can provide opportunities for Marines to create relationships with others who hold similar values. These social groups, have similar spiritual beliefs and can turn into physical fitness accountability groups or provide a Marine the mental support to remain resilient during intense physical tasks.

When physical fitness is addressed with spirituality, it involves an individual's participation in destructive behavior. For example, Dr. Harold Koenig, M.D., Director of the Center for Spirituality, Theology, and Health at Duke University, puts forth research that suggests substance abuse (i.e., alcohol or drug use) tends to be lower in individuals who have greater spiritual fitness. Spiritual fitness practices that help decrease destructive behaviors lead to health benefits such as decreases in chronic disease and more efficient physical training.

CHAPTER 5.
LEADERSHIP IN PHYSICAL FITNESS

The Marine Corps places great importance on physical fitness and expects Marines to strive to improve themselves while ensuring the team's success. Leadership is not limited to noncommissioned officers, staff noncommissioned officers, or commissioned officers. Every Marine can lead in the physical fitness realm. Improvement requires dedication and a desire to use the resources available.

PREPARING TO LEAD IN PHYSICAL FITNESS

Leaders must understand the resources and personnel available to help them prepare their Marines to reach optimal physical fitness. These resources and personnel can make the difference between success and failure, and leaders should use these resources their full extent.

Personnel and Resources

Every Marine is responsible for maintaining their overall fitness regardless of age, grade, or duty assignment, but the influence of good leadership creates a productive environment that provides space for physical fitness. Various uniformed and civilian personnel including an organization's FFIs, and installation-dependent personnel (e.g., athletic trainers, water survival instructors, martial arts instructors) are available to leaders.

The FFIs provide important education and skills. They help Marines meet the demands of MOS, duty assignment, physical fitness testing, and combat-specific tasks by designing programs to sustain or improve their physical fitness. A command can recommend potential fitness leaders among their ranks to attend the FFI training course. After completing the FFI course, the Marine can return to their units and be the resident expert in physical fitness.

Athletic trainers are available on select installations via the SMIP program. They are healthcare professionals who specialize in the prevention, examination, diagnosis, treatment, and rehabilitation of injuries and medical conditions. They provide the first-line response when an injury occurs; this care can include emergencies, "sideline," and clinical care.

Marine Corps Community Services is another resource that assists Marines in the physical fitness domain. They provide Marines and their families a variety of programs to enhance readiness and resiliency for warfighting, and improve overall quality of life. Services and personnel at each installation provide leadership with consistent support from one source.

Semper Fit. Semper Fit is a resource designed to help leadership anticipate and address problems before they occur. One of the main goals of Semper Fit is to help sustain optimal physical fitness to keep Marines combat-ready. This can be achieved through multiple programs that support physical fitness, such as health promotion, the Single Marine Program, recreational support, sports, and sports leagues.

DEVELOPMENT AND MAINTENANCE

A Marine's transformation begins the second a civilian decides to join the Marine Corps. Leaders throughout a Marine's career understand what it takes to sustain this transformation and must be diligent in doing their part. Foundations of leadership must be implemented to Marines' physical fitness transformation is also sustained. Concepts in this section were taken from Marine Corps Warfighting Publication (MCWP) 6-10, *Leading Marines*, and Marine Corps Tactical Publication (MCTP) 6-10A, *Sustaining the Transformation*.

Foundations of Leadership in Physical Fitness

The foundations of Marine Corps leadership can be applied to the physical fitness domain. First, leadership skills can be present in any individual, but certain factors help Marines set an example. The following are factors leaders must strive to master themselves and influence in others:

- *Morale*: the confidence in oneself that leaders instill through developing physical readiness.
- *Physical Readiness*: a multifaceted concept that requires Marines to prevail in difficult situations and combat.
- *Discipline:* a state of order and obedience that Marines obtain through training that mirrors physical demands during high pressure.
- *Physical Courage*: mastering fears such as harm or pain, so Marines can be prepared for the unexpected.
- *Physical Challenges*: effects from sleep deprivation, poor nutrition, and fear incorporated into realistic training.
- *Adaptability*: the ability to change training based on identified weaknesses, deficiencies, and outdated practices that are not effective.
- *Innovation*: the creatively applied training that improves Marines' motivation and facilitates progress.

It is the leader's job to anticipate and quickly recognize any obstacles that can arise. For example, while physical training during the summer at Parris Island, leaders can expect it to be hot and humid throughout the day with chances of thunderstorms and can be unsafe for Marines not acclimated to a new environment. While training needs to occur in realistic conditions, if their unit is not properly acclimated to an environment, adjustments to training (i.e., time of day training occurs) should be made for safety.

Obstacles can occur on various levels, affecting any aspect, from the entire Marine Corps to the individual. One example of a common obstacle is sustaining an injury during training or a job-related task. Injuries take a Marine from operating at 100 percent to less than their best. Leaders should understand that obstacles threaten their Marines' success and have resources readily available to help them through difficult situations.

PHYSICAL FITNESS READINESS AND RECOVERY

Leaders should dedicate a set time and schedule for physical training to help Marines prepare for operational tasks and physical assessments. Although everyone is ultimately responsible for their own physical fitness, leaders should set the example and create an environment that promotes effective training. Training should be innovative and provide options to choose from for their personal physical fitness programs and unit training. Physical fitness levels prior to deployment should not need major adjustments because current training should already have Marines ready to deploy. Minor adjustments may be required, such as acclimating to a different region or training on rugged terrain; such decisions are made at the leader's judgment.

Physical Fitness Improvement

When failure to meet fitness goals decreases Marines' readiness, leaders must consider disruptions to one or more of the MCTF domains that could contribute to these failures. These factors can include transitioning from deployed status, time available to train, participation in special conditioning programs, increased stress from external factors, and recovery from illness or injury.

Disruption Factors. Marines coming from training and education who are adjusting when returning from deployment or experiencing demanding life events can experience deconditioning. Deconditioning or weight gain can be factors that negatively influence a Marine's performance. New physical and psychological stress may require time for a Marine to acclimate to the unit's culture and the environment at a new location. These Marines need training programs specific to their needs to transition them to optimal fitness.

While deployed, leaders must make every effort to equip, program, permit, and lead physical fitness training. Deconditioning begins in as few as 14 days when Marines do not participate in training. Post-deployment might cause fitness levels to decline, and a Marine needs to return to or exceed their pre-deployment fitness levels. Most can achieve this without a special conditioning program, but some might need intervention. Marines should prepare for the PFT and CFT within 90 days of returning from deployment. In cases where a deconditioned Marine cannot achieve this goal, he or she should continue to participate in the unit's regular training program, modifying the training's intensity and frequency with guidance from SMIP program personnel.

Injury and Illness Prevention and Recovery

The leader's role in minimizing injury is to lead by being present during physical training and reconditioning sessions. Leader presence builds reputation and relationships with Marines who are working toward a return to full duty. No matter their level of conditioning or physical status, a leader's presence instills pride and a "can do" mindset. There should be no gap between SMIP program compliance and participation in the program. This includes instances where leaders who

are pregnant, injured, or deconditioned use the SMIP program modified drills and exercises, and train alongside their units. Their presence during special programs de-stigmatizes injury and demonstrates support for a key part of the warrior ethos: never leave a fallen comrade.

Leaders look for and resolve conflicts between the SMIP training schedule and the unit training schedule. By considering the physical demands of tasks on the unit training schedule, leaders can plan appropriate physical training sessions. For example, if Friday involves a ten-mile hike to a range, leaders should not schedule speed work on Thursday, and time should be allotted for recovery. Monday and Wednesday's physical training should not involve climbing drills or a strength training circuit if Tuesday's unit-training schedule takes the unit to an obstacle course that heavily challenges upper body strength.

Reconditioning drills and exercises provide Marines a standard to follow in all circumstances, but leaders can individualize reconditioning drills to meet unique needs. Force fitness instructors, athletic trainers, strength coaches s, and other healthcare providers aim to identify and treat injuries and to prevent injuries from happening in the first place. Units that use the SMIP program personnel will encounter fewer injuries and learn how to manage them.

Using SMIP program personnel can give the initial appearance of an increase in the rate and number of injuries. However, this occurs because personnel have learned to identify, diagnose, record, and treat injuries. Although this increased injury rate surprises some leaders, it is expected. These newly identified injuries and limitations are treated more quickly, and in the long-run, cause LIMDU rates to decrease because of early intervention.

As leaders use the SMIP program, with a proper conditioning program and earlier access to treatment, the risk of injuries decreases. These measures stop chronic or more serious injuries from developing. Those units that continue with non-standardized, random, non-periodized training often have a greater need for reconditioning programs.

Leaders who are challenged with minimizing injuries while conducting rigorous training must adhere to the fundamental principles of the SMIP program. Marines who are reconditioning through an injury should continue to train with their units, modifying the drills and exercises until they can perform them to standard and return to full duty as soon as possible.

Unit Surveillance Reporting. Whether an injury is acute or chronic, avoid "working through" the pain of an injury unless required by operation tasks and responsibilities (i.e., in combat environments). When a Marine experiences pain caused by a particular movement or activity, that movement should be modified or discontinued to decrease further harm. Some injuries require prompt medical attention, while others are not urgent. Marines should seek medical treatment if—

- The injury causes severe pain, swelling, or numbness.
- They are unable to tolerate weight on the affected body part.
- The pain or dull ache of an old injury is accompanied by increased swelling or joint abnormality or instability.

If the above symptoms are not present, it is probably safe to treat the injury at home, but if pain or other symptoms worsen within 24 hours, Marines should check with an appropriate medical provider such as an athletic trainer or physician.

The Dynamic Warm-Up. Marines should apply the RAMP mnemonic to help plan a dynamic warm-up before physical activity. It stands for—

- ***R****aise*: elevate the body temperature, heart rate, respiration, blood flow, and mobility.
- ***A****ctivate* and ***M****obilize*: muscle activation and joint mobility through dynamic flexibility and mobility drills with movement patterns that reflect the upcoming physical activity.
- ***P****otentiation:* increases the speed of neural impulses from the brain to the working muscle to perform contractions.

Dynamic warm-up phases allow a Marine to safely progress through the warm-up and prepare the body for the upcoming stress and strain. Table 5-1 provides an overview of each phase.

Table 5-1. Dynamic Warm-Up Phases.

Phase	Function
Phase 1: General Mobility	• Increases a Marine's blood flow. • Moves a Marine's joints through ranges of motion. • Work at low intensity.
Phase 2: Muscle Activation	Isolated movements to stimulate specific muscles.
Phase 3: Transit Mobility	• Move through specific ranges of motion over a set distance. • Reinforce athletic movement. • Increase dynamic flexibility. • increase to a moderate intensity.
Phase 4: Dynamic Mobility	• Move joints through rapid ranges of motion in multiple directions. • Intensity should be nearing 100 percent.

Flexibility and Mobility. Maintaining high levels of flexibility and mobility aids injury prevention as well as increases a Marine's strength and efficiency.

Influencing Factors. Improving one's flexibility and mobility through physical training is possible, but there are factors that cannot be changed. Two factors are important to consider while planning a well-rounded physical fitness program are—

- *Age*: as individuals age, their flexibility and mobility naturally decrease, particularly without a consistent physical fitness program.
- *Sex:* females are more naturally flexible compared to males; this is because there is a difference in hormone levels and tissue stiffness.

Three factors can be altered or controlled to positively affect flexibility and mobility; this includes the following:

- *Muscle Fibers*: these fibers can stretch and return to their original shape; excess muscle mass can decrease the muscle fibers ability to stretch and return without damage.
- *Connective Tissue:* tendons, ligaments, and fascia to keep joints from stretching too far, but adhesions can form when Marines lack sufficient warm-up and cool-down training or when they over train.
- *Activity Level*: active individuals are typically more flexible than sedentary individuals; progressive increases in activity levels and consistency help maintain physical fitness.

Methods to Improve Flexibility and Mobility. In groups where flexibility and mobility do not come naturally, it is important to recognize this as a possible area that needs increased attention. Resources such as FFIs, athletic trainers, strength coaches, and MCCS programs should be used to maximize this effort. There are four basic methods Marines can use to improve flexibility and mobility to include—

- *Static stretching:* Marines should use passive relaxation and muscle-lengthening exercises like the following:
  - Hold in the end ROM position for a minimum of 30 seconds two to three times.
  - To avoid injury, do not force a stretch too far, forcefully, or on a muscle that is not sufficiently warm.
  - Perform exercises within five to ten minutes after training, at the end of the cool-down phase.
- *Dynamic Flexibility:* is the active movement through ROM. It involves—
  - Athletic-based movement to reflect required physical tasks.
  - The coordination of multiple joints and muscles.
- *Muscle Activation*: nerves and muscle fibers recruitment to prepare the body for accurate and efficient movement for the required physical task(s).
- *Myofascial Release*: manual therapy that helps break up adhesions in the muscle's connective tissue includes the use of foam rollers, lacrosse balls, and other equipment, or it can be accomplished manually by qualified personnel.

Components of Unit-Led Competitive Conditioning. Unit leaders are responsible for developing, implementing, and executing holistic unit physical fitness programs. They are responsible for utilizing FFIs, water survival instructors, and martial arts instructors with MCO 6100.14, *Marine Corps Physical Fitness Program*. Commanders are responsible for ensuring FFIs use all available resources when designing unit fitness programs, including those beyond the organic capability of the unit (e.g., Semper Fit, base swimming pools, and additional MCCS programs).

Unit leaders must allow time for physical training as part of the daily routine. Physical training requirements can be accomplished through tactical movements or other occupational-related activities, swimming, Marine Corps martial arts, unit physical training, intramural sports, or individual training sessions. Plans should be challenging, enhance injury prevention, and include endurance, strength, and mobility training.

Scheduling competitive activities should be done progressively. These activities should be conducted as part of the program after a basic level of conditioning has been developed so muscles and joints can withstand the stress placed on them by sudden stops and turns, body contact, and falls. Competitive activities, however, should not be allowed to dominate the physical training program.

Competitive Units. Marine units should train and compete with the same organizations (battalions, companies, platoons). In most situations, the unit is the squad. Skill level should be considered when creating groups or teams. Having groups that are not balanced compete against each other can lead to unsportsmanlike conduct or physical injury.

Unit-Led Competitive Conditioning Events. Units may reach a training plateau where motivation and interest decrease. Introducing a change in physical training can help increase motivation and interest to break through the plateau.

Unit Team Contests. Team contests are activities that Marines compete in as a team. This differs from competitive activities in that it introduces more body contact and requires a solid physical fitness foundation. This foundation helps minimize injury risk by preparing the body for the stress and strain of athletics. These contests are not a substitute for, nor should they be used as a complement to, physical training.

Military Field Meets. Military field meets are a simple way to organize functional physical training with a competitive edge. These are team contests conducted on a station-to-station basis during a given period. Field meets are a good place to start to build healthy unit competition.

Team Athletics. Team athletics add variety to a physical fitness program. If team athletics are integrated into the program, the goal should be total participation and competition. Therefore, the games selected can be played by the skilled or the unskilled. Athletics provide a healthy competition that typically interests most individuals. These athletic contests are not a substitute and should be used as a complement to physical training.

Competitive Water Activities. If physical tasks require Marine units to conduct mission-essential water-related activities, water sports-competitive activities are an engaging way to develop endurance. Defined training can accomplish this, but motivation and cohesion can be enhanced with competitive training. This approach can provide variety and raise enthusiasm. Every unit member should participate.

TRAINING DIET AND NUTRITION

Leaders are responsible for enabling their Marines to maintain and improve their skills before conducting missions. Leaders should be able to inform their Marines how nutritional needs change based on upcoming operations and environment.

Pre-Activity and Operations

Depending on the activity and the individual's intensity, about one to four hours before field operations a Marine should eat a snack or small meal to maximize energy stores and focus on carbohydrates (about 0.5 to 1.8 grams per pound). Individual needs vary during a high-intensity activity; high protein, fat, and fiber intake can lead to digestive upset. A Marine should also restrict caffeine use (up to 200 milligrams) to boost cognitive and physical performance 30-60 minutes before an activity.

The following are examples of foods containing more than 30 grams of carbohydrates:

- Fruit (apples, carb-enhanced applesauce).
- Bread (snack bread, tortilla, filled bakery item).
- Pasta entrées (elbow macaroni, cheese tortellini).
- Snacks (cookie, candy).
- Beverage (carbohydrate fortified).

During Activity and Operations

To sustain energy needs during field operations, Marines should—

- Snack often (every hour if possible).
- Focus on consuming 30 to 60 grams of carbohydrates per hour during high-intensity operations.
- Drink fluid to prevent dehydration (16 to 32 ounces per hour).

The following are examples of food good to eat during operations with more than 30 grams of carbohydrates:

- Fruit (apples, carb-enhanced applesauce, dried fruit).
- Snacks (bakery items, or candy).
- Beverage (carb fortified).

After Activity and Operations

Within 30 to 60 minutes after field operations, a Marine should—

- Start recovery and refueling, consume 80 to 120 grams of carbohydrates and 15 to 25 grams protein after intense physical activity.
- Drink to replace fluid loss and prevent dehydration.

Post-field operation food could include the following:

- Recovery trail mix and pudding: 90 grams of carbohydrates and 17 grams of protein.
- Chocolate protein drink, peanut butter, and crackers: 90 grams of carbohydrates and 25 grams of protein.
- Meatballs in marinara sauce, Italian bread sticks, and beverage (carbohydrate fortified): 23 grams of protein and 85 grams of carbohydrates.

SLEEP READINESS

Leaders are responsible for the sleep readiness of their Marines and are expected to model positive behavior. Sleep readiness includes knowing the importance of sleep to mission success and applying healthy sleep behaviors to optimize physical fitness. Developing and implementing local sleep policies can improve the sleep habits of unit members and the unit's overall sleep culture.

For example, moving physical fitness training from morning to the afternoon or starting the duty day later are ways for Marines to sleep later, resulting in improved sleep, enhanced health, and reduced risk of injury, illness, and accident rates that improve unit morale. Three actions leaders can take to bolster their Marines' sleep health are—

- Make sleep readiness a priority by only allowing required operations and tasks take precedence oversleep.
- Know your own personal sleep habits, and the sleep habits of personnel; sleep is not, "one size fits all."
- Practice and promote good sleep hygiene; routines and habits that prepare the mind and body for sleep.

Changing Schedules

Leaders should aim to optimize their Marines' sleep to the extent possible given the existing operational constraints. Unit leaders should consider the following:

- *Consistency*: avoid rotating shifts every five to seven days and avoid rotating shifts more than twice per month.
- *Forward Direction*: rotate shifts in a forward direction; this type of shift system moves from a morning shift to an evening shift and then to a night shift which allows sleep to occur later in the new shift than it did in the previous shift. Bodies have difficulty adapting to backward shift rotations because they require earlier initiation of the sleep period.

Planning for Periods of Insufficient Sleep. Planning for sleep among the training and tactical environment requirements is a leadership skill. The goal in all operational scenarios should be to maximize sleep duration because more sleep results in greater alertness, resilience, mental acuity, and greater physical readiness. Some tips to help with sleep while deployed are—

- Organize sleep and living areas by shifts (i.e., keep the day areas separate from the night areas).
- Extra monitoring on the night shift due to increased risk of compromised alertness.
- Ensure off-duty safety by providing post-shift sleeping quarters or transportation (if necessary).
- Keep schedules simple (particularly for day sleepers) by making sure required briefings are scheduled around dining facility availability.
- Reverse the physical training schedule of afternoons versus mornings to ensure Marines receive adequate sleep (if feasible).

Safety. Operational or training environments should provide safe and secure places for Marines to sleep. This also applies to areas where Marines take naps. Ensure that Marines do not attempt to nap in front of, behind, or underneath trucks, tracked vehicles, or other vehicles. Marines need to avoid and protect against pests (e.g., use mosquito nets when appropriate). Before sleeping, Marines check that snakes, spiders, ants, and other creatures are not in the sleeping area, sleeping bag, or shoes. Leaders have a planning decision aid to help plan missions and predict the effects of any sleep-wake schedule on performance.

Post-Deployment. When possible, leaders should provide Marines the opportunity for extended sleep (ten hours in bed per night would be optimal) for several consecutive nights (for at least one week, if possible) before missions likely to involve significant sleep loss. Leaders should encourage Marines to take appropriate advantage of this opportunity for extra sleep.

ENVIRONMENTAL CONCERNS FOR LEADERSHIP

Heat, Cold, and Hypobaric Conditions

Marines should plan for three environmental conditions to avoid injury and illness: heat, cold, and hypobaric. In a hot environment, an unacclimated Marine will not be able to sufficiently cool the body. A cold environment carries a risk for cold injuries, such as frostbite, which affect the body's ability to perform and increases the risk of further injury and illness. Hypobaric conditions occur when barometric pressure is reduced at high altitudes, creating a low atmospheric pressure. The lower atmospheric pressure in high altitudes reduces oxygen delivery (hypoxia). On the other hand, when immersed in water, the body is exposed to greater pressure. This is called hyperbaric pressure (high atmospheric pressure).

Achieving Acclimatization. Each environmental condition requires unique training situations. Sitting in a sauna or outside will not help achieve heat acclimatization; however, working out in heat for approximately ten days should provide nearly total heat acclimatization. Workout intensity should be reduced to 60 to 70 percent during the first days and gradually increase. It is recommended that a unit should train individually or in pairs to acclimatize because group or unit training can increase the risk of heat injury. The goal of heat acclimatization is to increase tolerance to heat, not improve components of physical fitness.

The information and research on cold acclimatization is inconclusive. Some data suggests repeated exposure to the cold alters peripheral blood flow and skin temperature; these changes are small and insignificant. Field observations have shown chronic exposure of some areas of the skin, such as the hands, can provide greater cold resistance. This is not a recommended training method, especially with a short amount of preparation time, and the appropriate protective gear (e.g., gloves) should be used when necessary.

Preparing for conditions at high altitudes is less about physical preparation and more about understanding and mitigating expectations. At high altitudes (above 3,937 feet), there is less oxygen in the air, so respiration rate increases to maintain the amount of oxygen in the blood (at rest and exercise) and activity at altitude suffers. It may take approximately two weeks to adapt to conditions at 7,545 feet. A Marine might experience some general weight loss at altitude because muscle fibers can atrophy (decrease in size) up to 20 percent. Training pre-deployment or at high altitudes might be different than regular physical training.

APPENDIX A.
RESOURCES FOR MORE INFORMATION ON PHYSICAL FITNESS

The resources in Table A-1 are specific to this publication.

Table A-1. Physical Fitness Program Development Resources

Topic	URL	Content
Anatomy	https://www.hprc-online.org/physical-fitness/injury-prevention/understand-basic-musculoskeletal-anatomy-optimize-military	Understand basic musculoskeletal anatomy to optimize military fitness
Anatomy	https://www.hprc-online.org/total-force-fitness/tff-strategies/warfighter-brain-health-part-1-nervous-system	Warfighter brain health Part 1:Nervous system
Anatomy	https://www.hprc-online.org/total-force-fitness/tff-strategies/warfighter-brain-health-part-2-brain-health-total-force-fitness	Warfighter brain health Part 2: Brain health for total fitness
Anatomy	https://www.hprc-online.org/total-force-fitness/tff-strategies/warfighter-brain-health-part-3-neurotransmitters	Warfighter brain health Part 3: Neurotransmitters
Body Composition	https://www.hprc-online.org/physical-fitness/training-performance/optimal-body-fat-and-body-composition-military-fitness	Optimal body fat and body composition for military fitness
Breathing Control	https://www.hprc-online.org/mental-fitness/performance-psychology/basics-belly-breathing	Basics of Belly Breathing
Breathing Control	https://www.hprc-online.org/mental-fitness/sleep-stress/optimize-your-breath-tactical-breathing-optimize-performance-stress	Optimize breath: Tactical breathing to optimize performance, stress management, and military wellness.
Breathing Control	https://www.hprc-online.org/mental-fitness/sleep-stress/tactical-breathing-military	Tactical Breathing for the Military
Dangerous Practices	https://www.hprc-online.org/physical-fitness/injury-prevention/what-overtraining	What is overtraining?
Dangerous Practices	https://www.hprc-online.org/mental-fitness/performance-psychology/impact-social-media-performance-optimization-and-mental	The impact of social media on performance optimization and mental health.
Dangerous Practices	https://www.hprc-online.org/social-fitness/teams-leadership/social-media-conduct-military-wellness-and-career-success	How to use social media for better performance, resilience, and mental health.
Dangerous Practices	https://www.hprc-online.org/social-fitness/teams-leadership/social-media-conduct-military-wellness-and-career-success	Social media conduct for military wellness and career success.

Table A-1. Physical Fitness Program Development Resources (Continued).

Topic	URL	Content
Deployment	https://www.hprc-online.org/physical-fitness/training-performance/home-or-deployment-workouts-limited-equipment	At home or on deployment workouts with limited equipment
Deployment	https://www.hprc-online.org/total-force-fitness/navigating-deployment/maintain-your-fitness-deployment	Maintain fitness on deployment
Deployment	https://www.hprc-online.org/total-force-fitness/tff-strategies/navigate-shift-performance-tips-deployed-place-warfighters	Navigate the shift: Performance tips for deployed-in-place Warfighters and their families
Female Marine Considerations	https://www.med.navy.mil/Navy-and-Marine-Corps-Force-Health-Protection-Command/Womens-Health/	The Navy and Marine Corps Force Health Protection Command-Women's Health
Female Marine Considerations	https://www.womenshealth.gov/getting-active/physical-activity-menstrual-cycle	Physical activity and your menstrual cycle
Goal Setting	https://www.hprc-online.org/total-force-fitness/fighting-weight/check-your-holistic-military-wellness-goals	Check in with holistic military wellness goals
Goal Setting	https://www.hprc-online.org/total-force-fitness/tff-strategies/pcs-survival-guide-episode-1-goal-setting-and-resilience	PCS survival guide episode 1: Goal setting and resilience
Goal Setting	https://www.hprc-online.org/mental-fitness/performance-psychology/smart-goals-worksheet-performance-optimization	SMART Goals worksheet for performance optimization
Injury Prevention and Care	https://www.med.navy.mil/Navy-and-Marine-Corps-Force-Health-Protection-Command/Population-Health/Health-Promotion-and-Wellness/Wounded-Ill-and-Injured/Injury-Prevention/	Navy Medicine Injury Prevention
Injury Prevention and Care	https://www.hprc-online.org/social-fitness/family-optimization/everything-you-need-know-about-progressive-muscle-relaxation	Everything to know about progressive muscle relaxation to boost well-being and optimize performance
Injury Prevention and Care	https://www.hprc-online.org/physical-fitness/environmental-extremes/how-can-heat-acclimatization-prevent-heat-illness	How can heat acclimatization prevent heat illness?
Injury Prevention and Care	https://www.hprc-online.org/physical-fitness/injury-prevention	Injury Prevention
Injury Prevention and Care	https://www.hprc-online.org/physical-fitness/training-performance/optimize-your-workouts-proper-workrest-ratios	Optimize workouts with proper work rest ratios
Injury Prevention and Care	https://www.hprc-online.org/physical-fitness/training-performance/tai-chi-pain-management	Tai Chi for pain management
Injury Prevention and Care	https://www.hprc-online.org/physical-fitness/training-performance/understand-and-manage-pain	Understand and manage pain

Table A-1. Physical Fitness Program Development Resources (Continued).

Topic	URL	Content
Injury Prevention and Care	https://www.hprc-online.org/physical-fitness/training-performance/whats-safe-and-effective-way-begin-running-again	What's the safe and effective way to begin running again?
Injury Prevention and Care	https://ksi.uconn.edu/prevention/hydration/	Korey Stringer Institute
Maintenance	https://www.hprc-online.org/total-force-fitness/tff-strategies/4-total-force-fitness-strategies-navigate-transition-parenthood	4 Total Force Fitness strategies to navigate the transition to parenthood
Maintenance	https://www.hprc-online.org/mental-fitness/mental-health/guide-staying-resilient-times-crisis	A guide to staying resilient in times of crisis
Maintenance	https://www.hprc-online.org/total-force-fitness/tff-strategies/optimize-your-performance-prevent-burnout	Optimize performance to prevent burnout
Maintenance	https://www.hprc-online.org/mental-fitness/sleep-stress/practice-yoga-improve-physical-fitness-and-mental-fitness	Practice yoga to improve physical and mental fitness
Maintenance	https://www.hprc-online.org/physical-fitness/environmental-extremes/resources-operating-altitude	Resources for operating at altitude
Maintenance	https://www.hprc-online.org/physical-fitness/environmental-extremes/stay-active-and-maintain-military-fitness-through-cold	Stay active and maintain military fitness through cold, snowy winters
Maintenance	https://www.hprc-online.org/physical-fitness/training-performance/build-muscle-lighter-weights	Build muscle with lighter weights
Program Building	https://usmcfitforce.com	FitForce phone app
Program Building	https://www.marforres.marines.mil/Staff-Sections/Special-Staff/Marine-Corps-Community-Services/Semper-Fit/Conditioning-Programs/	Semper Fit Conditioning Programs
Program Building	https://www.hprc-online.org/physical-fitness/training-performance/gotmysix-your-fitness-battle-buddy	# Got my Six: Your fitness battle buddy
Program Building	https://www.hprc-online.org/physical-fitness/training-performance/guidelines-progress-your-physical-training-over-time	Guidelines to progress physical training over time
Program Building	https://www.hprc-online.org/physical-fitness/training-performance/introduction-foundational-movements-functional-fitness	Introduction to the foundational movements of functional fitness
Program Building	https://www.hprc-online.org/physical-fitness/training-performance/military-workout-core-strength-101	Military workout: Core strength 101
Program Building	https://www.hprc-online.org/physical-fitness/training-performance/military-workout-planning-beginners	Military workout planning for beginners

Table A-1. Physical Fitness Program Development Resources (Continued).

Topic	URL	Content
Program Building	https://www.hprc-online.org/total-force-fitness/tff-strategies/total-force-fitness-self-check-my-wellness-performance-inventory	Total Force Fitness Self-Check: My Wellness and Performance Inventory
Program Building	https://www.hprc-online.org/total-force-fitness/tff-strategies/track-your-habits-improve-your-performance	Track you habits to improve performance
Program Building	https://health.clevelandclinic.org/what-is-vo2-max-and-how-to-calculate-it/	What is VO2 Max?
Technique/Form	https://www.hprc-online.org/physical-fitness/training-performance/change-your-hand-position-optimize-your-workouts	Change hand position to optimize workouts
Technique/Form	https://www.hprc-online.org/physical-fitness/training-performance/load-carriage-strategies-improve-military-fitness	Load carriage strategies to improve military fitness

Table A-2 lists websites Marines can access for more information about nutrition.

Table A-2. Nutrition Resources.

Topic	URL	Content
Dangerous Practices	https://www.hprc-online.org/nutrition/performance-nutrition/underfueling-carbs-can-lead-underperformance-depth	Under fueling carbs can lead to underperformance
Dangerous Practices	https://www.hprc-online.org/nutrition/performance-nutrition/disordered-eating-growing-problem-military	Disordered eating: A growing problem in the military
Field Nutrition	https://www.hprc-online.org/nutrition/mne/optimize/work/optimize-your-nutrition-field-combat-rations-database-comrad	Optimize nutrition in the field with Combat Rations Database (ComRaD)
Food Preparation	https://www.commissaries.com/healthy-living/dietitian-approved-thumb	Commissary- Dietician Approved Thumb (DAT)
Nutrition Basics	https://www.hprc-online.org/nutrition/performance-nutrition/3-keys-optimal-nutrition	3 Keys to Optimal Nutrition
Nutrition Basics	https://www.hprc-online.org/nutrition/go-green/marketing/print-digital/posters/rethink-your-drink-sugar	Re-think the drink: sugar
Nutrition Basics	https://www.hprc-online.org/nutrition/warfighter-nutrition-guide	Warfighter Nutrition Guide
Nutrition Basics	https://www.Myplate.gov	US Department of Agriculture: Warfighter Nutrition Guide Warfighter Nutrition Guide My Plate
Nutrition Basics	https://www.Dietaryguidelines.gov	US Department of Agriculture and DHHS: Dietary Guidelines for Americans 2020-2025

Table A-2. Nutrition Resources. (Continued).

Topic	URL	Content
Performance Optimization	https://www.hprc-online.org/nutritional-fitness/performance-nutrition/fueling-road-or-foot-marches-basics	Fueling for road or foot marches: The basics
Performance Optimization	https://www.hprc-online.org/nutrition/performance-nutrition/fuel-stay-everyday-strong	Fuel up to stay everyday strong
Performance Optimization	https://www.hprc-online.org/nutrition/performance-nutrition/power-plate-eat-fuel-your-performance	Power Plate: Eat to Fuel Your Performance
Performance Optimization	https://www.hprc-online.org/physical-fitness/training-performance/trying-gain-muscle-use-these-fueling-strategies-bulk	Trying to gain muscle? Use these fueling strategies to bulk up
Supplements	https://www.opss.org/	Operation Supplement Safety

Table A-3 lists websites Marines can access for more information about sleep health.

Table A-3. Sleep Health Resources.

Topic	URL	Content
Performance Optimization	https://www.hprc-online.org/mental-fitness/sleep-stress/learn-how-sleep-impacts-your-performance	Infographic on sleep and performance
Performance Optimization	https://www.hprc-online.org/mental-fitness/sleep-stress/learn-how-sleep-impacts-your-performance	Learn how sleep impacts performance
Performance Optimization	https://www.hprc-online.org/mental-fitness/sleep-stress/sleep-readiness-optimize-your-performance-and-military-wellness	Sleep readiness to optimize performance and military wellness
Performance Optimization	https://www.hprc-online.org/mental-fitness/sleep-stress	Sleep and Stress
Sleep Assessment	https://www.hprc-online.org/mental-fitness/sleep-stress/sleep-vacation-one-way-transform-your-sleep-military-wellness-and	Sleep Self-Study Guide
Sleep Assessment	https://www.hprc-online.org/mental-fitness/sleep-stress/use-sleep-diary-worksheet-optimize-your-performance-stress-management	Sleep Diary
Deployment and PCS	https://www.hprc-online.org/total-force-fitness/tff-strategies/pcs-survival-guide-episode-2-staying-present-and-getting-0	PCS survival guide episode 2: Staying present and getting enough sleep
Sleep Education	https://www.nhlbi.nih.gov/files/docs/public/sleep/healthy_sleep.pdf	NIH Guide to Healthy Sleep (DHHS)
Sleep Education	https://www.cdc.gov/sleep/about/	CDC: About Sleep

Table A-4 lists websites Marines can access for more information about mental health.

Table A-4. Mental Health Resources.

Topic	URL	Content
Habit Building	https://www.hprc-online.org/mental-fitness/mental-health/build-strategic-habits-optimize-performance-resilience-and-mental	Build strategic habits to optimize performance, resilience, and mental health
Mindfulness and Focus	https://www.hprc-online.org/mental-fitness/performance-psychology/mindfulness-meditation-primer	A mindfulness meditation primer
Mindfulness and Focus	https://www.hprc-online.org/mental-fitness/mental-health/stress-mindset-self-check-tips-optimize-performance-mental-health-and	Stress Mindset" self-check: Tips to optimize performance mental health, and resilience
Mindfulness and Focus	https://www.hprc-online.org/mental-fitness/performance-psychology/impact-social-media-performance-optimization-and-mental	The impact of social media on performance optimization and mental health
Mindfulness and Focus	https://www.hprc-online.org/social-fitness/relationship-building/importance-positive-emotions-performance-optimization-mental	The importance of positive emotions for performance optimization, mental health, and strong relationships.
Performance Optimization	https://www.hprc-online.org/mental-fitness/performance-psychology/5-mental-rehearsal-tips-optimize-performance-and-stress	5 mental-rehearsal tips to optimize performance and stress management
Performance Optimization	https://www.hprc-online.org/total-force-fitness/tff-strategies/imagery-improves-your-total-fitness	Imagery improves total fitness
Performance Optimization	https://www.hprc-online.org/mental-fitness/sleep-stress/individual-zone-optimal-functioning-izof-your-stress-sweet-spot	Individual zone of optimal functioning (IZOF): The stress "sweet spot"
Performance Optimization	https://www.hprc-online.org/mental-fitness/performance-psychology/optimize-performance-through-positive-self-talk	Optimize performance through positive self-talk
Resources and Help	https://www.militaryonesource.mil	Military OneSource

Table A-5 lists websites Marines can access for more information about social fitness.

Table A-5. Social Fitness Resources.

Topic	URL	Content
Performance Optimization	https://www.hprc-online.org/physical-fitness/training-performance/group-workouts-boost-team-camaraderie	Group workouts boost team camaraderie
Performance Optimization	https://www.hprc-online.org/social-fitness/teams-leadership/lead-pack-boosting-your-social-skills	Lead the pack by boosting social skills
Performance Optimization	https://www.hprc-online.org/total-force-fitness/gotmysix/resources/social-support-your-total-fitness-strategy	Social support: Total-fitness strategy

Table A-6 lists a website Marines can access for more information about spiritual fitness.

Table A-6. Spiritual Fitness Resource.

Topic	URL	Content
Performance Optimization	https://www.hprc-online.org/resources-partners/ssfs/champ-socom-spiritual-fitness-scale-ssfs	CHAMP SOCOM Spiritual Fitness Scale (SSFS)

APPENDIX B.
EXPANDED CONCEPTS OF ANATOMY, PHYSIOLOGY, AND BIOMECHANICS

SKELETON COMPOSITION

Bones have four layers, which are—

- *Periosteum*: the membrane that surrounds and protects the bone.
- *Compact (Cortical) Bone*: is the bone that the periosteum surrounds, compact bone is the dense outer layer that provides support and protection.
- *Spongy (Cancellous) Bone*: a bone's inner layer, which contains small holes to give a sponge-like appearance and is found in the ends of long, short, and irregular bones.
- *Bone Marrow*: makes up the bone's center and is stored in spongy bone; produces blood cells.

CARTILAGE TYPES

Cartilage is strong connective tissue, and its purpose is to provide support, absorb shock, and facilitate smooth movement at joints. There are three types of cartilage:

- *Hyaline* (*articular) cartilage*: lines the ends of bones to create a smooth surface to decrease friction during movement.
- *Fibrocartilage*: thick and tough, but flexible cartilage to help cushion joints (e.g., the meniscus in the knee and vertebral discs).
- *Elastic cartilage*: very flexible cartilage that allows movement, but returns to its original shape (e.g., the ears, nose, and larynx).

Functions of the Lower Extremity

The lower extremities consist of the foot, ankle, knee, and hip joints. Each joint has unique names that describe the bones that are articulating. Every joint is responsible for specific ROMs and uses specific muscles to move. Table B-1 describes the lower extremity body parts' biomechanics.

Table B-1. Biomechanics of the Lower Extremity by Body Part.

Body Part	Joint Name(s)	Range of Motion	Muscles
Ankle	Talocrural Subtalar	• Plantarflexion • Dorsiflexion • Inversion or Eversion • Supination and Pronation	• Gastrocnemius • Soleus • Peroneals (longus and brevis)
Knee	Tibiofemoral	• Flexion • Extension	• Quadriceps • Hamstrings
Hip	Acetabulofemoral Rotation	• Flexion or Extension • Abduction or Adduction • Circumduction	• Hip Flexors • Tensor Fascia Latae • Gluteus Maximus • Gluteus Medius • Hip Rotators

Upper Extremity Joint Functions

The upper extremity joints are the shoulder, elbow, wrist, and hand. Table B-2 describes the upper extremity joint functions.

Table B-2. Biomechanics of the Upper Extremity by Body Part.

Body Part	Joint Name(s)	Range of Motion	Muscles
Shoulder	Glenohumeral	• Flexion • Extension • Rotation • Abduction or Adduction • Circumduction	• Rotator Cuff • Deltoids
Elbow	Humeroulnar Radioulnar	• Flexion • Extension • Supination • Pronation	• Biceps brachii • Brachialis • Triceps brachii • Supinators and Pronators
Wrist	Distal Radioulnar	• Flexion • Extension • Radial and Ulnar Deviation	• Extensor carpi radialis longus and brevis • Flexor carpi radialis and ulnaris • Brachioradialis
Hand	Carpometacarpal Metacarpophalangeal Interphalangeal	• Flexion • Extension • Abduction orAdduction • Opposition	• Extensors • Flexors • Thenar and Hypothenar • Interossei and Lumbrical

The Spine and Trunk Functions

The spine and trunk sections are the cervical, thoracic, and lumbar spine, and the anterior abdomen. Table B-3 describes the trunk's biomechanics.

Table B-3. Biomechanics of the Trunk by Section.

Body Part	Sections	Range of Motion	Muscles
Cervical Spine	C1-C7	• Extension • Lateral Flexion • Rotation	• Extensors • Upper Trapezius • Levator Scapulae • Sternocleidomastoid • Scalenes
Thoracic Spine	T1-T12	• Extension • Elevation and Depression • Protraction and Retraction • Rotation	• Mid and Lower Trapezius • Rhomboids • Serratus Anterior
Lumbar Spine	L1-L5	• Flexion • Extension • Lateral Flexion • Rotation	• Latissimus Dorsi • Extensors • Transverse Abdominis
Abdomen	Anterior	• Flexion • Lateral Flexion • Rotation	• Rectus Abdominis • Transverse Abdominis • External/Internal Obliques

DIRECTIONAL TERMS

Directional terms are universal definitions that help describe anatomical locations.

- *Superior and Inferior:* are above and below (i.e., the knee is superior to the foot).
- *Proximal and Distal:* are near and far in relation to a specific joint (i.e., the knee is proximal to the hips, the feet are distal to the hips).
- *Medial and Lateral*: are towards or away from the midline from the body (i.e., the inside the knee is medial, the outside the knee is lateral).
- *Anterior and Posterior*: the front and back of a body in anatomical position (i.e., the quadriceps are anterior; the hamstrings are posterior).
- *Superficial and Deep*: closer or farther from the skin's surface (i.e., the cut is superficial and does not need stitches).

ROLES OF MUSCLE

Muscles perform three roles that allow them to work together to create balanced movement as well as provide stability for the body's skeletal structure. This includes agonist, antagonist, and stabilizer muscles. The agonist is the primary mover, similar to the biceps when performing a curl. The antagonist is the muscle that opposes the agonist, similar to the triceps during a bicep curl. The triceps (antagonist) must relax and stretch for the biceps (agonist) to bend the elbow. As the elbow straightens the biceps is still doing most of the work, but the triceps can assist to help slow

or stop a movement to help prevent injury and decrease fatigue of the biceps. Other muscles that are not responsible for the movement but are around the moving joint are called stabilizers. These muscles help begin the movement and stabilize the elbow during a bicep curl.

BIOMECHANICS

Biomechanics is how the skeleton and muscles (musculoskeletal system) create movement. For the body to perform efficiently, one must understand how the body moves and interacts with its environment. Compare this to the way a rifle operates. Each piece of a rifle serves a specific purpose, and the functions affect each other to cause a round to discharge. When there is malfunction in one rifle piece, it may cause a breakdown of the order of operations necessary to fire.

Biomechanical Factors

Biomechanical factors include the following:

- *Friction*: the force that results from the two objects resisting or moving against one another. For example, running depends on the friction between a Marine's feet and the ground so the Marine pushes off and moves forward; when friction is reduced, the Marine is more likely to slip.
- *Balance*: the ability to maintain a desired position to complete a task or the equal strength and movement distribution.
  - A Marine must maintain balance on uneven terrain during hikes or on an obstacle course.
  - For example, after a significant injury to a limb, strength and movement decreases compared to the healthy side and need to be addressed to avoid compensation and additional injury.
- *Stability*: how much the body resists being put off balance and produces countering power; factors that affect stability include base of support, center of gravity, and mass. Stability can be enhanced by wearing the proper footwear for physical activity and operational tasks.

Biomechanical Properties of Tendons and Ligaments

Tendon and ligament properties can change due to several variables. Factors that affect biomechanical properties of tendons and ligaments include the following:

- *Maturation and Aging*: ligaments and tendons decrease their elastic properties.
- *Mobilization and Immobilization*: physical activity has shown to increase ligament strength and stiffness while immobilization decreases tensile strength.
- *Steroids*: corticosteroids are applied after an acute ligament injury to minimize inflammation; ligament stiffness decreases, energy absorption decreases, and the failure point decreases.
- *Grafts*: a graft used to repair or replace a ligament and takes about one year for the healing process to be complete. In theory, the graft should be stronger than the other side. Due to compliance or early return to training, the graft might have more laxity.

Gait

Gait is the established pattern of walking. Biomechanical changes in gait can affect strength, performance, and efficiency. The gait phases are heel strike, mid-stance, push off, and swing phase.

Abnormal Gait

Injuries can result from poor foot and ankle mechanics from abnormal gait patterns. This can occur from injury or anatomical structures of an individual. If problems occur, the following factors may be present:

- Odd wear patterns on their shoes or boots.
- Visible wear and tear on shoes or boots that decrease their stability.
- Inefficient movement of the ankle or hips.
- Uneven sounds of foot strikes

WOLFF'S LAW

Wolff's Law is the observation that healthy bone will respond and adapt to the physical stress it experiences. In other words, when a physical fitness program follows a proper progression, the program enables the bone to withstand the stress it experiences over time by becoming stronger so it can handle more load. Marines who experience excess stress on their bones such as during hikes need to progress their distances in a thought-out physical fitness program.

SPECIFIC ADAPTATIONS ON IMPOSED DEMANDS PRINCIPLE

The Specific Adaptations on Imposed Demands (also called SAID) is to soft tissue, as Wolff's Law is to bones. Stress placed on the body is going to create a reaction and if a physical fitness program addresses all components of physical fitness and is appropriate for the fitness level, the body should respond with overall improvements in strength, endurance, power, etc. When more stress than the body can physically handle occurs, it can adapt by causing injuries and/or illness.

Emphasis on program progression and recovery is key to using this principle to one's advantage. For example, a Marine who is struggling during the CFT's ammo can lift needs to incorporate more overhead muscular strengthening and endurance exercises. They should begin similar movements with a lighter weight and controlled sets and repetitions and increase them over time. A Marine can set a goal of completing a specific number of repetitions with lighter weight in the same amount of time they have for the ammo can lift during the CFT. If they can complete their goal, they know they are ready to move onto a heavier load.

APPENDIX C.
MORE INFORMATION ON COMMON INJURIES

COMMON INJURIES AMONG MARINES

Strains and Sprains Severity

Strain and sprain severity is classified into three grades:

- *Grade I:* "overstretched" with minimal to no tearing; little to no swelling or pain, and minimal effect on performance.
- *Grade II:* minimal to mild tearing with moderate pain, bruising, swelling, possible deformity, point tenderness, mild to moderate laxity (sprains only), and noticeable decreases in performance.
- *Grade III:* severe or complete tearing (rupture) with pain, swelling, point tenderness, deformity, bruising, loss of movement, severe laxity (sprains only), and significant decreases in performance.

Fractures

Fractures are broken bones. They are common due to the risk involved with a Marine's physical tasks that include a high chance of blunt forces or falls. The nine fracture types are —

- *Blowout*: an eye socket fracture.
- *Comminuted*: the bone fractures into three or more pieces.
- *Linear*: occurs parallel to the length of the bone.
- *Oblique:* occurs diagonally across the bone.
- *Transverse*: occurs perpendicular to the length of the bone.
- *Compression:* opposite forces push on the bone to cause collapse; common in the spine.
- *Greenstick*: incomplete fracture; most common in undeveloped bone (adolescent ages).
- *Compound:* also called an open fracture; the bone breaks through the skin's surface.
- *Avulsion*: a tendon or ligament pull a small piece of bone away from the larger piece.

Impingement

Impingement is often referred to as the "pinching" or compression of one or more structures in the body. Most often, it occurs in smaller spaces that contain tendons, nerves, and blood vessels. This is a common musculoskeletal injury for Marines because of the high loads they endure during physical activity (particularly in the upper body). Common signs and symptoms of musculoskeletal injuries can include numbness, tingling, and decreases in strength to the affected area the nerve innervates. Figure C-1 depicts an impingement injury.

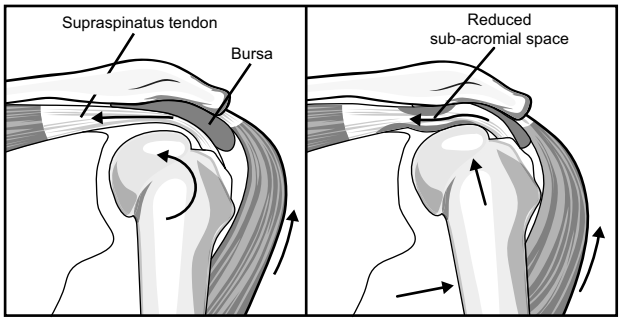

Figure C-1. Impingement in the Shoulder.

Lower Back Pain

Pain located to the lower back and hips and may or may not be associated with a specific incident or injury. Low back pain is common among Marines for various reasons. In addition to common signs and symptoms there may be pain that reaches across the lower back, numbness and tingling, significant decrease in trunk ROM and strength.

Marines should avoid exercises that make pain worse (if it hurts, do not do it), including hyperextensions, (e.g., prone back extensions), rotational exercises, squats, and deadlifts. Complete inactivity should be avoided as it will often make pain worse. Activity should be light, such as walking and stationary core exercises (e.g., planks and glute bridges) if it does not make pain worse.

Neck and Upper Back Pain

Pain located in the neck and upper back can occur after sudden head and neck movements or may have no distinct cause. This pain is common in individuals who wear night vision goggles often and for a long time. In addition to common signs and symptoms numbness and tingling and significantly decreased range of motion happens.

Avoid exercises that make pain worse, including hyperextensions, sitting at a desk, pull ups, rows, wearing heavy pack or plate carrier. Qualified medical professionals can recommend modifications for physical activity. Myofascial release techniques (foam roll or tennis ball) and stretching tend to help relieve symptoms. Overall improvement in posture with releasing anterior shoulder tightness and improving posterior shoulder strength are helpful for long-term goals and prevention.

Neurological Injuries

Neurological injuries are injuries that affect the nerves and their functions in the body. During physical training nerves have important functions such as motor control and body temperature regulation. In addition to common signs and symptoms neurological injuries may include radiating pain down a limb, decrease in muscle function, muscle atrophy, numbness, tingling, and abnormal sensations such as burning, fire, electric-like feeling, or a zap or tingling sensation.

If a neurological injury is suspected, the Marine must stop physical activity and be referred to a healthcare professional. A Marine should rest and participate in cross training for the body parts that are not injured to maintain cardiorespiratory fitness, muscular strength, and endurance. A Marine should slowly progress back to activity under a medical professional's guidance to avoid reoccurrence. If conservative treatment fails, surgery may be needed.

Concussions

During a concussion, forces cause the brain to move and hit the sides of the skull which causes neurons to die and chemical changes. A qualified healthcare professional can conduct a neurological and cognitive evaluation to see if an individual has a concussion. Bloodwork or scans cannot diagnose a concussion.

Concussions rarely present with tangible signs or symptoms. Symptoms could appear immediately or be delayed within 24 to 72 hours. It is a myth that losing consciousness causes concussions. Signs and symptoms for immediate referral to the emergency department or to call 9-1-1 include: losing consciousness, having a severe headache, vomiting, slurring speech, impaired vision, and behavior changes. Marines who show symptoms should be referred to a medical professional for help. Mild symptoms include—

- Headache.
- Trouble falling or staying asleep.
- Memory loss.
- Confusion.
- Irritability.
- Dizziness or loss of balance.
- Ringing in the ears.
- Sensitivity to light or sound.
- Nausea or vomiting.
- Fatigue.

If a concussion is suspected, immediately stop activity and seek medical attention. After a concussion has been diagnosed, follow the guidance of a medical professional. Avoid using screens (phones, computers, television, etc.) and bright spaces. Follow the medical professional's suggestion for return progression to avoid future complications and symptoms.

Post-Concussion Syndrome

Post-concussion syndrome is a condition after an individual sustains a concussion, but recovery takes longer than it should, especially if the Marine is compliant with treatment and any rehabilitation. It is a continuation, plateau, or worsening of one or more symptoms of a concussion. Post-concussion syndrome can be debilitating and interfere with everyday personal and work life. Referrals to specialists such as a neurologist or physical therapist who specializes in post-concussion care might be necessary for recovery.

Second Impact Syndrome

Second impact syndrome is a result of an individual sustaining a second concussion before the initial concussion is healed. This injury causes the brain to swell within the skull and requires immediate surgical intervention. Second impact syndrome can lead to severe brain damage and death. A Marine should never return to activity following a concussion until the injury has fully healed and they have been cleared by medical. This injury occurs most often in brains that are not fully developed, which does not occur for some individuals until after 20 years of age or older.

Signs and symptoms occurs within seconds to minutes. They include but are not limited to: disorientation, losing consciousness, respiratory failure (not breathing), and death. Typically, death occurs within ten minutes without surgical intervention.

Immediately call 9-1-1 and perform CPR and use the AED if available. Recognizing and diagnosing the initial concussion is crucial and a preventative measure to ensure an individual does not develop second impact syndrome. The Marine is expected to adhere to all treatment requirements healthcare professional gives. No leader should allow a Marine with a concussion to continue activity or leave the area unattended.

Subdural Hematoma

Subdural hematomas occur after a severe blow to the head causing blood to pool in one area between the brain and skull. This condition can lead to sudden death. They are officially diagnosed with a scan, most often a CT scan or MRI. Figure C-2 depicts a subdural hematoma.

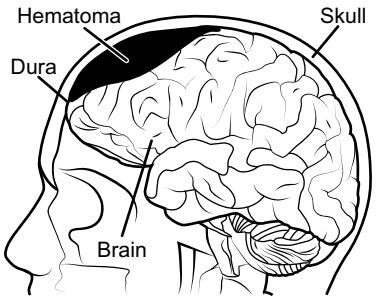

Figure C-2. Subdural Hematoma.

They have similar signs and symptoms to a concussion, but their severity can quickly progress. Progression ranges from ten minutes to a few days to weeks, and it depends on where the bleeding is and speed of bleeding in the brain. A rapid increase in the individual's feeling of "sleepiness" is a common sign of a subdural hematoma.

It is critical that a Marine is removed from activity and closely monitored following any head injury. Marines must not return to activity until the head injury has been fully healed and a medical professional has cleared them to return to activity. The Marine should be kept awake for three to four hours and monitored. Medicine should not be administered because anti-inflammatories can increase the speed of bleeding and symptoms can worsen or can be masked.

Disordered Eating

Although it is a key component of RED-S, disordered eating can occur in men or women. Disordered eating and eating disorders share some commonalities, but it's important to note they are not the same. Disordered eating refers to abnormal eating patterns, while eating disorders are clinically diagnosed. If disordered eating continues without intervention eating disorders can develop. Disordered eating warning signs include the following:

- Excessive leanness or rapid weight loss.
- Obsession with weight, food, mealtime rituals and body image.
- Avoid team meals, or secretive eating.

- Fluctuations in weight.
- Daily vigorous exercise in addition to regular training sessions.
- Stress fractures.
- Skin turning yellow (jaundice).
- Soft, "baby" hair on the skin.
- Frequent sore throats despite no other signs of respiratory illness (from self-induced vomiting).
- Chipmunk-like cheeks from swollen parotid glands (from self-induced vomiting).
- Many dental cavities and/or foul breath (from self-induced vomiting).
- Fatigue, light-headedness, or dizziness.
- Depression or low self-esteem.

Amenorrhea

An unbalanced diet, inadequate caloric intake relative to physical activity level and excessive training can predispose females to menstrual abnormalities. Any woman who misses three consecutive periods or has periods that occur at intervals of greater than 35 days should be evaluated by a physician. Before attributing menstrual abnormalities to exercise, other conditions such as pregnancy, reproductive organs abnormality, or thyroid disease must be ruled out.

Osteoporosis

Osteoporosis refers to low bone mass and the skeletal body being fragile. Low estrogen levels and other hormonal changes, which accompany irregular or absent menstrual periods, can predispose females to osteoporosis. A 20-year-old woman without menses during critical bone mass stage development may have the bone mass typical of a 70-year-old woman. This predisposes them to skeletal injuries such as fractures. Adequate nutrition fosters good bone formation. Calcium requirements for young women with typical menses is 1,200 milligrams per day. Females with irregular or absent menses require 1,500 milligrams of calcium and 400 milligrams of vitamin D per day.

Muscle Dysmorphia

Muscle dysmorphia is an obsessive preoccupation with one's muscularity, size, and leanness. It is suggested to be a subtype of body dysmorphic disorder, where an intense preoccupation with a minor (real or perceived) body imperfection exists and greatly disturbs health-related quality of life; in this instance, the flaw would be one's level of muscularity. This disorder can "hide well" within the military culture. Recognizing muscle dysmorphia and typical signs and symptoms includes the following:

- Having a Type-A personality.
- Dissatisfaction with body image.
- Experimenting with supplements.
- Prioritizing workouts over other duties.

RECOGNITION OF OVERTRAINING

There are three levels of overtraining in exercise, each level depends on how long symptoms have been present:

- *Functional overreaching*: lowest level with small and short-term decreases in performance; can be improved with a well-rounded periodized workout plan.
- *Nonfunctional overreaching:* middle level has other physical and mental symptoms.
- *Overtraining syndrome*: more severe than nonfunctional overreaching and requires several months to recover; diagnosis should come from a qualified medical professional and other issues should be ruled out.

Overtraining levels signs and symptoms in individuals includes the following:

- Decreased performance.
- Excessive and constant fatigue.
- Sleep trouble.
- Appetite changes.
- Irritability.
- Restlessness.
- Anxiety.
- Weight loss.
- Burnout.

RECOGNIZING EXERCISE ADDICTION

There are seven criteria that can help Marines identify if someone has an exercise addiction. These include—

- Tolerance is when an individual exercises more to feel more accomplished or successful.
- Withdrawal is when an individual experiences negative effects such as mood swings and sleep problems when they are not able to exercise.
- Lacking control happens when an individual is unable to reduce exercise intensity levels or refrain from exercise.
- Intention effects happens when individuals cannot stick to intended routines (e.g., increase exercise time, mileage, etc.).
- Time when an individual's time is spent planning, doing, and recovering from exercise.
- Reduction in other activities happen when social and occupational activities are enjoyed and happen less or not at all.
- Continuance is when individuals continue to exercise even if the individual is aware, it is creating or making physical, mental, or social problems worse.

GLOSSARY

Section I: Abbreviations and Acronyms

CFT	combat fitness test
DoD	Department of Defense
MCCS	Marine Corps Community Services
MCO	Marine Corps Order
MCRP	Marine Corps reference publication
MCTP	Marine Corps tactical publication
MOS	military occupational specialty
PFT	physical fitness test

The following abbreviations and acronyms are specific to this publication.

ATP	adenosine triphosphate
FITT	frequency, intensity, time, and type
FFI	force fitness instructor
MCTF	Marine Corps Total Fitness
RED-S	relative energy deficiency syndrome
RHR	resting heartrate
RIR	repetitions in reserve
RPE	rate of perceived exertion
SMART	specific, measurable, achievable, relevant, time-bound
SMIP	Sports Medicine Injury Prevention
TBI	traumatic brain injury

Section II: Terms and Definitions

The following definitions are specific to this publication.

Aerobic
Physical activity performed with the use of oxygen for energy.

Anaerobic
Physical activity performed without the use of oxygen for energy.

Appendicular skeleton
The part of the skeleton that is made up of the upper and lower extremities.

Axial skeleton
The part of the skeleton that is made up of the head, spine, and thorax (ribs).

Biomechanics
Study of the body and how it moves and functions with the musculoskeletal system.

Blood pressure
The amount of force on the walls of blood vessels after the heart pumps it out.

Cardiovascular system
The body systems that includes the heart, blood, and its vessels to deliver blood to all parts of the body, essential for transporting oxygen.

Dislocation
Ajoint forced out of alignment that must be manually put back into alignment.

Fast-twitch muscle fiber
Muscle fiber that is quick to contract but fatigues easily; used most in high intensity activity that requires speed and power.

Flexibility
The ability for a body part to move through its range of motion without restriction.

Functional Fitness
Physical training that resembles and improves physical fitness related to required physical tasks.

Heart rate
The number of times a heart beats per minute.

Hypertrophy
The increase of muscle mass due to an increase in physical training and activity.

Ligaments
Non-elastic tissue that attaches bone to bone at their articulations to provide stability and allow appropriate movement.

Macronutrient
Nutrients needed in larger quantities from food to sustain proper nutrition and energy; macronutrients are carbohydrates, protein, and fat.

Metabolism
The body's process to create energy to fuel life-sustaining functions.

Micronutrient
Vitamins and minerals required in small amounts and sustain good health.

Mobility
The ability of the body to move through movement patters and is influenced by motor function and flexibility.

Muscular endurance
The ability of a muscle to perform work for a long and continuous amount of time.

Muscular power
the ability of a muscle to perform work quickly and with great strength.

Muscular strength
the ability of a muscle to move a heavy load.

Musculoskeletal system
The body system that includes bones (skeleton), muscles, tendons, ligaments, and connective tissue.

Myofascial system
The muscle and the connective tissue that surrounds and supports it.

Proprioception
The awareness of the body in space that includes position and timing.

Slow-twitch muscle fiber
Muscle fibers that are slow to contract but can withstand fatigue to perform longer.

Spirituality
Finding personal faith, values, and morals that guide a person in life and can provide motivation and purpose.

Sprain
Injury to a ligament that involves overstretching and/or tearing.

Stigma
Anegative thought or perception about characteristics or physical attributes of a person that stem from misinformation or falsehoods.

Strain
Injury to a muscle or tendon that involves overstretching and/or tearing.

Subluxation
Partial displacement of a bone from its normal joint position.

Tendon
Elastic tissue that connects muscle to bone and helps facilitate movement.

Tendonitis
Inflammation of a tendon that causes pain and possible decreases in performance.

REFERENCES AND RELATED PUBLICATIONS

Department of Defense Issuances

Department of Defense Instruction (DoDI)

1330.04	Military Services Participation in National and International Sports Activities
6130.06	Use of Dietary Supplements in the DoD

Department of Defense Manual (DoDM)

1338.10	DoD Food Service Program

Navy/Marine Corps Departmental Publications (NAVMCs)

3500.18D	Marine Corps Commons Skills Volume 1 Training and Readiness Manual
3500.41C	Training Military Occupational Specialties and Training and Readiness Manual.

Marine Corps Issuances

Marine Corps Warfighting Publication (MCWP)

6-10	Leading Marines

Marine Corps Tactical Publication (MCTPs)

3-30E	Combat and Operational Stress Control
6-10A	Sustaining the Transformation

Marine Corps Reference Publication (MCRP)

6-10.1	Spiritual Fitness Leader's Guide

Marine Corps Orders (MCOs)

10110.14N	Marine Corps Food Service and Subsistence Program
10110.49	Nutrition and Menu Standards for Human Performance Optimization
1500.52D	Marine Corps Water Survival Training Program (MCWSTP)
1500.59A	Marine Corps Martial Arts Program (MCMAP)
1500.62	Force Fitness Instructors Program (FFIP)
5351.1	Combat and Operational Stress Control Program
6100.3	Physical Fitness
6100.13A	Marine Corps Physical Fitness and Combat Fitness Tests (CFT/PFT)

Marine Administrative Message (MARADMINs)

404/21 Forthcoming Changes to the Physical Fitness Test

621/16 MCPFP and the Role of the Force Fitness Instructor

Miscellaneous

Marine Corps Supplement to the DoD Dictionary of Military and Associated Terms