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ABSTRACT *(MAXIMUM 200 WORDS)*

The USMC is a physical culture that places special emphasis on physical as well as functional fitness. However, the Marine Corps assesses physical training in traditional ways and misses other key elements such as such as nutrition, sleep, and stretching. Numerous case studies, pilot programs, and existing practices show the benefits of physical therapy, particularly through the use of the Functional Movement Screen (FMS). Other research indicates the benefits of proper nutrition, sleep, and stretching as part of a balanced fitness approach. This paper will demonstrate the value in investing time and resources in other aspects of physical fitness, such as nutrition, sleep, stretching, and in particular physical therapy, in order to improve the health and readiness of the total force. The Marine Corps needs a more comprehensive approach, which focuses on preventative measures and considers all aspects of physical fitness, to planning and conducting physical fitness training. The USMC should resource select units with physical therapists, or at a minimum use the FMS, and small unit leaders should develop more comprehensive physical fitness plans that emphasize preventative measures.

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TITLE: Improving Physical Fitness through Physical Therapy and Preventative Measures

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Sample Executive Summary

Title: Improving Physical Fitness through Physical Therapy and Preventative Measures

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Thesis: The United States Marine Corps (USMC) can create healthier Marines and increase unit readiness by emphasizing a holistic approach and preventative measures to physical training, particularly through the use of physical therapy.

Discussion: The USMC is a physical culture that places special emphasis on physical as well as functional fitness. However, the Marine Corps assesses physical training in traditional ways and misses other key elements such as such as nutrition, sleep, and stretching. Numerous case studies, pilot programs, and existing practices show the benefits of physical therapy, particularly through the use of the Functional Movement Screen (FMS). Other research indicates the benefits of proper nutrition, sleep, and stretching as part of a balanced fitness approach. This paper will demonstrate the value in investing time and resources in other aspects of physical fitness, such as nutrition, sleep, stretching, and in particular physical therapy, in order to improve the health and readiness of the total force.

Conclusion: The Marine Corps needs a more comprehensive approach, which focuses on preventative measures and considers all aspects of physical fitness, to planning and conducting physical fitness training. The USMC should resource select units with physical therapists, or at a minimum use the FMS, and small unit leaders should develop more comprehensive physical fitness plans that emphasize preventative measures.

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THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

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Acknowledgments

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The United States Marine Corps (USMC) is a culture that emphasizes physical as well as functional fitness. However, the Marine Corps assesses physical training in traditional ways and misses other key elements such as such as nutrition, sleep, and stretching. This neglect leads to increased risk for injury for individuals and decreased readiness for units. Marines may have a lifetime of pain and disability associated with their service, which potentially leads to increased disability costs, premature administrative separation, or medical retirement. There is room for improvement in the way in which the Marine Corps approaches and conducts physical training and fitness. The Marine Corps can create healthier Marines and increase unit readiness by emphasizing a more holistic approach and preventative measures to physical training, particularly through the use of physical therapy.

This approach will mean healthier Marines, who spend less time at medical for light or limited duty issues, who are available for worldwide deployment, who can perform better on evaluated events such as the Physical Fitness Test (PFT) and Combat Fitness Test (CFT), and who are more prepared for the unknown demands that will be placed on them, particularly in a combat environment. First, the USMC should resource select units with physical therapists to establish a baseline level of functionality for the individual Marine, enable more personalized training plans, and conduct periodic reevaluations to monitor progress. Second, small unit leaders should develop more comprehensive physical fitness plans that emphasize preventative measures.

This paper will demonstrate the value in investing time and resources into other aspects of physical fitness, such as nutrition, sleep, stretching, and in particular physical therapy, in order to improve the health and readiness of the total force. Using doctrinal publications, Marine Corps Orders, and existing guidance, as well as research from medical professionals and existing

literature, this essay will demonstrate that while the status quo with respect to physical fitness is adequate, improvements can be made.

This paper is organized broadly into three main parts: context, argument, and counter-argument. The context will review existing guidance, literature, and statistics related to physical fitness. The argument will make the case that physical therapists should be staffed at select units and that small unit leaders should embrace a change in how to conduct physical fitness. The counter-argument will provide reasons that these changes are not necessary. This paper will conclude by refuting the counter-arguments and summarizing the key points.

The Marine Corps is well aware of the benefits, both tangible and intangible, of physical fitness, and foundational publications reaffirm the importance of training and physical fitness to enable successful combat operations. Marine Corps Doctrinal Publication – 1, *Warfighting*, updated in 1997, does not explicitly address the conduct of physical fitness; however, it does discuss training in general terms. It states that training is conducted in order to prevail in combat; that training should be decentralized; and that leaders should provide sufficient time for subordinate leaders to conduct training.[1] Marine Corps Warfighting Publication 6-11, *Leading Marines*, updated in 2014, references the value of physical conditioning and states "physical conditioning is one method of reducing the effects of fatigue, increasing self-confidence, and reducing stress."[2] Unfortunately, this broad guidance does not address the reality that many, especially more senior Marines, have billets where physical fitness is not as crucial to mission accomplishment in the short term. These Marines will eventually assume other billets that have different demands, and all Marines must be prepared to deploy in support of operations.

In 2015, then-Commandant of the Marine Corps, General Joseph F. Dunford, issued his *Commandant's Planning Guidance*. One of the emphasized sentences in this document states

"My expectation is that all Marines and all Marine units are physically and mentally ready to deploy to every clime and place, at any time."[3] This sentence can have both surface and deeper meanings, but one of the potential meanings includes being deployable worldwide. This is not to say that Marines who are injured and on limited duty (LIMDU) have done something wrong and cannot contribute to the institution; rather, that those Marines should be treated so they can return to a full duty status and deploy in support of operations. Ideally, Marines spend minimal or no time on limited duty and are physically capable of performing their duties at all times. The goal for all leaders is to have healthy Marines.

Additional guidance regarding physical fitness can be found in both Marine Corps Order (MCO) 6100.13 W/CH 2, *Marine Corps Physical Fitness Program*, dated 30 January 2015, and MCO 6110.3 W/CH 1, *Marine Corps Body Composition and Military Appearance Program*, dated 8 August 2008. MCO 6100.13 provides policy and procedural guidance to implement the Marine Corps Physical Fitness Program (MCPFP).[4] It states that physical fitness is a component of both combat readiness and leadership, and all Marines must be physically fit.[5] Further, the first indicator of an effective fitness program is that it contributes to the "overall health and wellness of every Marine through regular exercise, proper nutrition, health education and periodic physical and combat fitness evaluation."[6] Similarly, MCO 6110.3 emphasizes a comprehensive approach for Marines to maintain height and weight standards. In the commander's intent, MCO 6110.3 acknowledges a relationship between the MCPFP and maintaining proper body composition and states "it is essential the Marine Corps develop a comprehensive program that will enhance Marine wellness…in order to improve Marine combat readiness and personal appearance."[7] While each order has a different focus, both are related to

the health and wellness of individual Marines so they can perform their duties, especially in a combat environment.

In order to comply with the intent of these various doctrinal publications, guidance, policies, and orders, all Marines, particularly those in leadership positions, have a role. Unit leaders should develop comprehensive programs to increase personal fitness levels. There are multiple facets of physical fitness and some, such as nutrition, are explicitly covered in the MCOs. To have a comprehensive program, one cannot simply focus on exercise. A comprehensive program must include other factors that are also more preventative in nature, such as nutrition, sleep, and stretching. Additionally, physical therapy, while used in the past for rehabilitative purposes, should also be used in a more preventative way. Each of the above listed four factors has unique benefits to complement exercise.

Among the four other factors, nutrition is the one factor that is common to both the physical fitness and body composition MCOs. Nutrition is a key component of any fitness plan, either to control weight or to increase performance. According to Katie Kirkpatrick, a nutritionist with the Uniformed Services University Consortium for Health and Military Performance, nutrition plays a role in multiple ways with respect to physical performance. Proper nutrition provides fuel for muscles; aids in the repair of existing muscles or the building of new muscles; supports the body through strong bones, healthy joints, and endurance; and it also replaces lost nutrients during physically demanding tasks.[8] Approximately 35% of U.S. adults are obese, and since the society from which the USMC recruits has an impact on the force, nutrition is an important factor for Marines.[9] If Marines are unaware of how to maintain a proper diet, that could contribute to less than optimal physical performance, health problems, and the inability to meet the strict height and weight standards of the Marine Corps.

Sleep is another key component of physical fitness; however, it is often overlooked and underemphasized within the Marine Corps. Marines undergo intense training to be able to function in a sleep deprived environment, but some Marines underestimate the value of having a consistent, quality sleep routine. It is common for Marines to stand duty for a 24 hour period, and they are expected not to sleep during this time. The necessity to function in a sleep deprived environment may impact physical readiness. Dr. Nancy Wesensten and Dr. Thomas Balkin show the need for sleep within the military.[10] The authors note several negative impacts on both mental abilities and physical health due to a lack of sleep, and those who are chronically sleep deprived may also suffer from other health concerns, such as heart disease, obesity, and impaired immune function.[11]

The third factor, stretching, is also often minimized during physical training. While units are increasingly using dynamic warm-ups to begin a training session, stretching is not typically emphasized, outside of entry level training or other schools, at the conclusion of training. Static stretching involves holding a stretch for a period of time and is beneficial for increasing flexibility.[12] According to Dr. Duane Knudson, evidence shows that static stretching during a warm up actually can degrade other measures of muscular performance, such as strength and endurance, and does not aid in injury prevention.[13] Instead Knudson advocates for dynamic stretching or warm-up prior to conducting physical training and advocates for static stretching following the conduct of physical training since this will maximize the benefits of stretching, increasing overall flexibility and lowering “passive muscular tension and specific joint angles” in the long term.[14] There are other forms of stretching that may offer benefits for Marines as well. Foam-rolling, which is a form of self-massage using a foam roller, has increased in popularity. One of its benefits is breaking up soft tissue, which then leads to increased blood flow. This

increase in blood flow allows nutrients to repair damaged muscles and can assist in a post-workout recovery.[15]

The final factor, physical therapy, has historically been used by the Marine Corps for rehabilitative purposes in military treatment facilities (MTF) or the Sport Medicine and Rehabilitative Treatment (SMART) Centers, located at Camp Pendleton and Camp Lejeune.[16] Physical therapy can be described as a health care profession that uses different forms of cost-effective treatment to improve mobility, relieve pain, reduce the need for prescription drugs or surgery, and allow patients to participate in a personalized treatment plan.[17] However, physical therapy is not limited to post-injury care. One study, which was conducted in a hospital emergency room setting by a group of four physical therapists, from Washington University School of Medicine, demonstrated that physical therapists are uniquely qualified to identify movement and postural faults, assess the origin of those problems, and determine if physical therapy is not an appropriate solution.[18]

A more holistic approach to conducting physical fitness is necessary, and other Marines also concur with this sentiment. From January 2010 to November 2015, the *Marine Corps Gazette (MCG)* published 46 articles relating to physical fitness, with 11 of those published between November 2014 and November 2015. These articles explore a range of issues, and three of these articles highlight some of the deficiencies with the current fitness program.

Lieutenant Colonel (LtCol) Michael Reilly wrote in a 2012 *MCG* article that the institution does not place the proper emphasis on fitness and focuses on the fatness of Marines rather than the fitness of Marines. LtCol Reilly makes multiple recommendations, such as abolishing the current height/weight standards and placing a higher importance on PFT/CFT scores for promotion and command selection, to improve the current system.[19] He believes the

promotion system provides a disincentive for more senior Marines to maintain high levels of fitness. In his view, simply passing the PFT/CFT, or even having a low 1st class score in either event, and meeting height/weight standards does not necessarily mean that a Marine is fit.[20]

The *MCG* published an article by Captain (Capt) Jason Crutchfield, "Evolving Our Physical Training", in May 2015, in which he argues that the institution should address the manner in which it conducts physical training.[21] He states that physical training tends to focus on aerobic based exercises with little strategy and that restorative work is an afterthought.[22] Capt Crutchfield makes valid points, and some lessons from the article include that leaders take a more deliberate approach when developing physical training schedules to challenge multiple metabolic pathways, increase general purpose training, and include post-exercise maintenance as part of individual recovery. One example of challenging multiple metabolic pathways is to incorporate total body exercises periodically into a run.

Lastly, Private (PVT) David Johnson states in his October 2015 *MCG* article "PT Conundrum" that units routinely train their Marines to perform better on the PFT or CFT, based on the time of year, and that this type of training is not beneficial from a fitness or leadership perspective.[23] He calls this type of training isolation training and argues that a more balanced approach, such as incorporating events to prepare for both the PFT and CFT on alternating days, should be taken when developing training plans.[24]

Based upon this small sample of *MCG* articles, one can see that there are a variety of opinions regarding the need for change with respect to the physical fitness program and what that change could be. Some of these arguments are bold and require dramatic changes, while others are less dramatic. Regardless of the specific topic, Marines ranging from first term to career Marines, argue that the status quo is insufficient and that some changes should be made to

improve physical fitness. However, these articles do not focus on improving physical fitness through preventative measures, and none of the 46 *MCG* articles since 2010 explore the role physical therapy could have in the Marine Corps fitness program.

Before examining the role physical therapy could have though, it is worth noting the current state of fitness quantitatively. There are several metrics one can use to measure if Marines are healthy, fit, and ready to deploy; however, one can also argue these current metrics are not useful.[25] In 2015, the average PFT score and CFT score in the USMC was 248 and 289 respectively. There are 1,786 Marines, approximately 1% of the force, assigned to the Body Composition Program (BCP), which is designed to get Marines within weight standards if they do not meet the standard. Of all the Marines on LIMDU status, due to an injury or condition that prevents their full participation in unit training, there are 73 Marines who are categorized as non-deployable due to medical reasons. This statistic excludes many other categories of LIMDU, non-deployable Marines such as those who are pregnant, injured in a combat zone, or administratively non-deployable. There are 1,817 Marines on either the Permanent Disability Retired List (PDRL) or the Temporary Disability Retired List (TDRL). These categories are for those Marines unable to perform their duties due to a disability and are subsequently placed in a retired status. They are either given a permanent status or a temporary status based on the severity of the condition and their time in service.[26] From 2007-2015, both the PFT and CFT scores remained relatively consistent and both BCP and medical non-deployable numbers decreased. These are positive indicators. Overall, based on these statistics, one can reasonably assess that active duty Marines are in fact capable of performing their duties and deploying from a physical readiness perspective.

Table 1: Average PFT and CFT Scores

Year	PFT Score	CFT Score
2007	241	N/A
2008	242	N/A
2009	241	281
2010	242	280
2011	244	284
2012	246	286
2013	247	288
2014	248	289
2015	248	289

Source: Data derived from a report generated by Manpower Systems Division (MI), Manpower & Reserve Affairs (M&RA), HQMC, sent to the author on 1 December 2015.

Table 2: Number of Marines on BCP, PDRL-TDRL, or medically non-deployable

Year	BCP	PDRL-TDRL	Non-Deployable (Medically)
2007	2,169	709	1,148
2008	2,258	678	713
2009	3,049	901	528
2010	2,880	733	281
2011	2,825	923	215
2012	2,066	1,401	175
2013	1,946	1,832	116
2014	1,778	1,510	112
2015	1,786	1,817	73

Source: Data derived from a report generated by Manpower Systems Division (MI), Manpower & Reserve Affairs (M&RA), HQMC, sent to the author on 1 December 2015.

Even if these metrics are a valid assessment of fitness, there are some concerns. First, just because Marines have a first class PFT or CFT score does not necessarily mean they are fit and healthy. Second, and the most concerning statistic, is with respect to PDRL or TDRL. Those numbers rose dramatically from 709 in 2007 to 1,817 in 2015.

Perhaps the institution is not getting heathier; but rather, those who are unhealthy are simply transitioning out of the Marine Corps. Physical therapy and a new approach to fitness can mitigate some of the problems or concerns identified in the *MCG* articles and from the current statistics relating to physical fitness.

Physical therapy is currently used within the Marine Corps in only very limited and traditional ways, primarily in a rehabilitative manner. Most physical therapists reside at a MTF and treat patients after an injury. At Marine Corps Base (MCB) Quantico, there are three physical therapy clinics with six physical therapists on staff. In 2014, the MCB Quantico physical therapy clinics treated approximately 28,000 patients from a combination of new and follow up appointments.[27]

A gradual shift is occurring that recognizes the value of physical therapy as a preventative measure. According to Dr. Stephen Stoecker, Physical Therapy Department Head at Naval Health Clinic Quantico, the Department of Defense is beginning to integrate both physical therapists and athletic trainers within units to maintain the health of the force. Commands in Quantico, such as Officer Candidates School (OCS) and The Basic School have physical therapists on staff and hired athletic trainers recently as well. Athletic trainers focus more on presentation and acute injury and physical therapists focus more on rehabilitative care, but both have similar skill sets that can be used within a military organization. One distinction is that uniformed physical therapists, who can perform the same duties as athletic trainers, can deploy; whereas athletic trainers, who are civilian contractors, cannot deploy.[28]

The Marine Corps Special Operations Command (MARSOC) provides another example of the Marine Corps utilizing physical therapists. Brad Lambert, a physical therapist who serves as the Human Performance and Resiliency Program Manager within MARSOC, states that physical therapists are an embedded resource at the battalion level. MARSOC has eight physical therapists; a combination of two military, one civil servant, and five contractors; as well as one physical therapist assistant, a contractor, and two physical therapists technicians, both military. The number for the staff is based on the National Collegiate Athletic Association Division-1

standard of one physical therapist for every 300 athletes. Mr. Lambert states that the embedded nature is the key since it enables quicker access to care. The average wait time for a MARSOC Marine to see a therapist is an average of half a day as compared to the average MTF access to care of 7-14 days.[29]

A third example of the Marine Corps using physical therapists within units comes from a pilot program in which the 24th Marine Expeditionary Unit (MEU) Command Element had an embedded physical therapist from September 2009 to August 2010.[30] Navy Lieutenant (LT) John Fraser, the physical therapist assigned to the 24th MEU, provided a number of roles and services during this pilot program. Some of his duties included providing early detection, diagnosis, and treatment of injuries to return Marines rapidly to full duty, reducing the time for Marines to access specialty care, developing injury prevention initiatives, and enhancing warfighter performance.[31]

The purpose of this pilot program was to increase unit readiness and test the utility of providing a physical therapist in a USMC unit, primarily by addressing musculoskeletal injuries (MSK-I). MSK-Is represent the leading non-battle related injury, were the leading cause of medical evacuation (MEDEVAC) in both Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), and cost an average of 16 duty days and an average of $1,900 per MSK-I.[32] By embedding a physical therapist in an operational unit, Marines and the unit commander would have access to a specialist who could help prevent, evaluate, and treat MSK-I.[33] During this program, LT Fraser provided care to approximately 1,400 Marines and Sailors with MSK-I, managed 95% of MSK-I, saved 22,400 light and limited duty days, and prevented 20 potential MEDEVACs during deployment saving an estimated $144,000.[34]

Within the population of this pilot program, nearly 40% of the Marines reported having a MSK-I. They also reported they do not seek care for their injury due to "lack of access to specialized care, lack of confidence in primary care, perception of weakness, or laziness."[35] These reasons represent a range of barriers for Marines to see a physical therapist, even when therapists are in MTFs. Despite these challenges, approximately 50% of the Marines reported a desire to increase their physical performance and more Marines sought care after others spoke positively of the program and realized they would not be removed from their unit by seeking treatment.[36]

While LT Fraser performed many of the same duties as a physical therapist in a MTF, he also did more through other initiatives that were preventative in nature. He taught Staff Non-Commissioned Officers and Non-Commissioned Officers to develop them into "coaches" who could mentor their Marines on preventative measures such as conditioning and precautions. Fraser published a newsletter style article periodically to discuss fitness issues, such as barefoot running, to inform the Marines and provide professional advice to the Marines. Fraser also taught individuals and provided them with personalized training plans to improve physical performance. Improving performance was the goal of these initiatives, but prevention is not mutually exclusive from improving performance. There was a reduction in injury risk and an increase in performance by increasing knowledge and providing guidance.[37]

Based upon this pilot program, LT Fraser and others in Medical Service Corps recommended a change to the II Marine Expeditionary Force (MEF) table of organization. The recommendations varied by Major Subordinate Command (MSC) and totaled adding 20 physical therapists within the MEF. The breakdown of physical therapists by MSC is as follows: Command Element: 6; Division: 8; Wing: 5; and Marine Logistics Group: 3.[38] This request

reached the Marine Forces Command Commanding General's level in March 2011 but was tabled for a future time due to the moratorium on the change of table of organization process.[39]

With respect to prevention, physical therapists can perform certain functions. Physical therapists can identify problem areas before someone needs to see a medical doctor. Dr. Gray Cook, an orthopedic physical therapist and a strength and conditioning specialist, developed one way, called the Functional Movement Screen (FMS), to identify deficiencies in movement.

The FMS consists of seven different movements: squat, step, lunge, reach, leg raise, push-up, and rotation. The evaluator observes the patient perform each movement, and the patient has three opportunities to perform the movement. The evaluator scores each movement on a scale of 0 to 3, for a maximum score of 21. A score of 3 represents perfect execution; a score of 2 represents imperfect form or compensation during execution; a score of 1 represents inability to complete the movement due to stiffness, loss of balance, or other issue; and a score of 0 represents the patient experiencing pain during the movement, even if it is executed correctly.[40] Dr. Stoecker agrees that using the FMS can produce benefits. He believes that the FMS can serve two primary purposes. First, it can identify any concerns, such as instability or weakness, even if there is not currently pain. Second, it can help prevent future problems by identifying potential problem areas early before they become more serious over time.[41] Using the FMS is a significant shift since the FMS is a more qualitative evaluation compared to a PFT or CFT.

Dr. Cook states the importance of identifying weak links and argues that only by improving upon a weakness will someone become stronger. He uses an analogy of an athlete who identifies a deficiency in endurance, so the athlete begins an aggressive conditioning program to perform better. He also states that while an injury is easy to identify if there is one traumatic event, such as during a collision or fall, more often, people experience pain more

gradually in the absence of a single noticeable event. Dr. Cook refers to this progression of pain as microtrauma and describes it as "small amounts of stress imposed on the body over time caused by poor biomechanics and overtraining."[42] Moreover, he states that other factors also play in role in microtrauma: inadequate warm-up or cool-down periods, poor nutrition, and preferential training that is focused on one aspect of exercise at the expense of other forms of exercise.[43] In essence, Dr. Cook identified many of the problems facing those who exercise regularly over a decade ago, but Marines continue to have chronic pain. Based upon the demands of the occupation and regular physical training, it is easy to understand why some Marines, especially after spending, more than 20 years on active duty, complain about knee pain, low back pain, or other forms of chronic pain.

Dr. Cook believes that when treating a patient, instead of focusing on the specific compliant or problem, a better approach is to evaluate the whole person by observing them perform certain basic movements. He developed the FMS for this purpose; he wants to identify the root cause of a problem and correct that issue. Dr. Cook states, "an athlete who is unable to perform a movement correctly, shows a major limitation within one of the movement patterns, or demonstrates an obvious difference between the function of the left and right side of the body has uncovered a significant piece of information that may be the key to reducing the risk of chronic injuries, improving overall sport performance, and developing a training or rehabilitation program that helps the athlete advance to a higher level of competition."[44] By adopting this approach, the Marine Corps could act proactively and identify weakness in Marines. While a Marine may have no obvious difficulty in performing their duties or passing the PFT or CFT, the Marine could benefit from an approach that examines if he or she is moving correctly to mitigate chronic pain or injury and improve performance. To emphasize the target population and

purpose, the FMS is a screening system designed for healthy individuals in which the evaluator observes basic movement patterns that normally functioning people conduct, and this screening will identify movement limitations and asymmetries.[45]

Marines undergo a medical examination prior to entering the service at the Military Entrance Processing Station (MEPS) in which certain basic physical tests and screening is conducted, such as height and weight measurements, urine and blood tests, and a physical examination and interview.[46] Dr. Cook calls this type of evaluation a pre-participation medical examination in which the goal is to determine general health and determine if medical problems will interfere with performing certain tasks.[47] After this initial screening, Marines are not required to have an annual physical examination; instead the Periodic Health Assessment (PHA) is used to gauge overall health and wellness.

Marines regularly undergo performance evaluation, specifically in the form of PFTs and CFTs; however, there are flaws with solely using these tests to evaluate the health and fitness of a Marine. Dr. Cook considers this a form of performance testing in which the goal is to determine a level of strength, endurance, agility, or other specific skill set.[48] There is a gap though between the physical examination at MEPS and the PFT/CFT, and the FMS is intended to fill this void. The FMS can determine if a Marine is moving properly. If not, future injuries can occur due to microtrauma mentioned earlier. According to Dr. Cook, by placing the FMS at this point "it does not take for granted complete and acceptable functional movement patterns. It is possible to have good health and still move poorly."[49] Furthermore, if leaders only use the PFT or CFT to evaluate the physical condition of their Marines then then could miss problems. The FMS will identify any basic movement limitation and asymmetries and mobility and stability problems.[50]

Researchers have used the FMS in studies to determine the utility of this screening tool in predicting injury. The reason this is important is the prevalence of MSK-I, particularly in military populations, and the associated costs of those injuries. Most medical evacuations, 24%, in Operation Iraqi Freedom and Operation Enduring Freedom from January 2004 to December 2007 were due to MSK-I, while combat injuries represented the second highest cause of evacuations at 14%. Additionally, MSK-I contribute to "lost duty days, missed training, early attrition from the service, and diminished combat effectiveness."[51] Three recent articles reported on the use of the FMS specifically on military populations: two studies examined Marine officer candidates at OCS and one study examined cadets at the United States Coast Guard Academy (USCGA). Overall, the three studies had slightly different results, but all show that using the FMS is somewhat useful to predict injuries.

Knapik, et al. studied 770 male and 275 female USCGA cadets from July 2004 to September 2007 during the conduct of the 8-week Summer Warfare Annual Basic training.[52] Research staff members, to include physical therapists, conducted the FMS and identified training-related injuries, and a separate group of researchers screened the medical records at the end of the training cycle.[53] The researchers determined the FMS scores of 11 and 14, for men and women respectively, maximized the ability to predict injury. The study showed "moderate prognostic accuracy for injury risk among female Coast Guard Cadets but relatively low accuracy for predicting injuries in male cadets" using the FMS.[54]

A second study, published in 2011 by O'Connor, et al., also studied the utility of using the FMS to predict injury. The researchers studied 874 male USMC officer candidates in the summer of 2009 with the goal of determining if the FMS was a better predictor of injury than the PFT score.[55] While this study identified that the PFT score predicts injury equally as well as the

FMS, the authors cite several advantages of using the FMS.[56] First, by using the FMS, the potential exists to perform rehabilitative intervention.[57] Second, if properly trained, anyone can conduct the FMS. An instructor from Functional Movement Systems certified the staff through participation in a workshop, practical application, and successful completion of a written exam.[58] The Marine Corps could certify Marines, similar to certifying a command physical training representative, if a physical therapist is unavailable to perform the FMS.

A third study by Lisman, et al. used the same data from the O'Connor, et al. study but analyzed the data for a different purpose. This study, published in 2013, examined the association between individual components of the PFT and the FMS to injury.[59] The authors note that the PFT and FMS are designed to test different things by stating "the PFT assesses aerobic endurance and upper body and abdominal muscular endurance, whereas the FMS likely captures functional limitations related to deficiencies in proprioception, stability, and overall mobility."[60] Going into greater detail than the 2011 study, Lisman, et al. found greater predictive value by combining run time results and the FMS. It shows that a combination of a slow run time, defined as 7 minutes per mile or slower, and a FMS less than or equal to 14, enables the greatest predictive capability. Candidates with this combination of scores were four times as likely to experience injury.[61]

The three previous case studies demonstrate the FMS has some utility in practice. There are also other examples of applying an intervention strategy based on the FMS results to improve fitness and reduce injury. In 2007, Peate, et al. showed a decrease in lost time due to injury and a decrease in the number of injuries of firefighters, by 62% and 43% respectively, after improving strength and flexibility for those with FMS scores less than 17.[62] Some professional football teams are also using the FMS in a limited capacity for players with a history of injuries. The

Indianapolis Colts are using the FMS more proactively. In 2010, the Colts began using the FMS to improve problem areas for their athletes with all players taking the FMS on the first day of training camp. The team policy is that unless an athlete scores a 14 on the FMS, then they are not allowed to lift weights until the deficiency is corrected. The goals are to increase flexibility and symmetry and to decrease chronic injuries since a lack of flexibility or asymmetry can increase the risk for injury. David Coburn, who administered the FMS for the Colts, states "You can prevent chronic injuries."[63] This program provides an example of a business concerned with the health and wellness of its employees and using the FMS to improve their performance.

A 2012 dissertation by Carol Kennedy-Armbruster highlights the relationship between fitness and other aspects of wellness, such as functional movement ability, and evaluates the value in an intervention program.[64] This study examined active duty military personnel, ranging in age from 38-50, at three Navy bases from 2007-2012. One of the key findings was that strength, flexibility, and body composition are focal points to improve functional movement ability.[65] One of Kennedy-Armbruster's points is that while the military provides facilities and infrastructure for personnel to exercise regularly, that may not be enough to improve overall health of the military population. Instead of focusing on doing enough to pass a physical fitness test, the military should invest in personal relationships to increase health. She states, "Prior active duty research focused on passing a fitness test as the impetus for incorporating exercise into work routines. Current trends point toward the need for more human interaction…as well as an emphasis on functional movement."[66] Kennedy-Armbruster also discusses using the FMS and references a 2010 study by Minick, et al that found that novice evaluators using the FMS could accurately assess individuals if they are trained. In the conclusion the authors write, "individuals who have undergone the standardized training protocol will score the FMS in a similar

manner."[67] The value of this is that the USMC can use the train-the-trainer approach to implement the FMS across the force.

Beyond physical therapy, there is another way in which the USMC can improve the physical fitness program. The second part of the approach involves minimal to no increase in costs. It simply requires engaged leadership and a shift in mentality. Even in the absence of physical therapists, as is currently the situation, small unit leaders, those who are at the company level and below, can develop more comprehensive physical training plans that incorporate the other aspects of fitness: nutrition, sleep, and stretching. Unit leaders have a responsibility to set the conditions, allocate adequate time, and provide access to resources for their subordinates to succeed.

Solutions to developing more comprehensive physical training plans are quite simple. Leaders can emphasize these other aspects on a regular basis and not simply focus on exercise when conducting unit physical training. There are a number of ways in which unit leaders can emphasize these aspects. They can talk with the Marines about why nutrition, sleep, and stretching are important, which can be done in group settings or in individual counseling sessions. They can develop a post-training stretching plan and incorporate that into the already allotted time; taking 5-10 minutes at the end of the session, even at the expense of doing exercises, will not be a waste of time. Leaders can allocate time in the schedule to enable the Marines to get the proper nutrition and sleep. Typically, Marines are not given adequate time to go to the chow hall or eat a balanced meal before having to begin the work day. Unit training is normally scheduled early in the morning and little thought is given to how much rest they had the night before or if they will eat a nutritious meal after training. Marines will eat after training, but if they are not given the time to go to the chow hall, then they will resort to eating quick

meals or unhealthy snacks in their room. A sample plan could involve beginning training at 0700, conducting training from 0700-0745, then conducting stretching from 0745-0800. The unit leader can then allocate one hour of recovery time to allow Marines to eat properly and come to work. This is only a one hour session, but starting slightly later in the day and factoring stretching, nutrition, and sleep into the timeline make subtle, but important changes. Additionally, unit leaders can simply lead by example. Subordinates are more likely to change their daily habits with respect to fitness, nutrition, and sleep if their leaders are good models.

There are three main counterarguments to resourcing units with physical therapists. First, there is not enough funding to staff units. Staffing physical therapists within units is not a feasible course of action in this fiscally-constrained environment since the costs are prohibitive. The average annual total cost, when factoring in base salary and other benefits, for a physical therapist and a physical therapy assistant is $118,000 and $78,000 per year respectively.[68] Second, there is not sufficient time in the schedule to allow for every Marine to see a therapist. Third, the USMC has a comprehensive fitness program, high intensity tactical training (HITT), which can cover the functional movement issues addressed. HITT is a strength and conditioning program designed to optimize combat readiness, improve operational readiness, and complement existing programs. In short, it aims to increase Marines' athleticism.[69]

These points are well-taken, but there are also flaws with these counter arguments. First, since there is no appetite to increase force structure at this time or for the foreseeable future, senior leaders must decide on priorities. Also, the numbers of medically retired represent a potential long-term problem in terms of financial cost to society as well as potentially lower quality of life for those Marines. A way to mitigate these costs is to have healthier Marines while they are on active duty. If funding does not increase, then an option is using the existing health

care providers; medical officers (MO), independent duty corpsmen (IDC), or corpsmen, to monitor the FMS. Furthermore, designated Marines could perform the FMS after appropriate training. This model is similar to having HITT trainers or martial arts instructors within units, and they could be prime candidates for this additional duty. Research, specifically by Minick et al., shows that people can be trained to perform the FMS. Additionally, Dr. Cook advocates that many types of professionals can use the FMS.[70]

Second, there is never enough time to do everything unit leaders want to do which is why prioritization and time management are important skills for leaders. One way to gain efficiency is to modify and improve the current PHA. All Marines must complete the PHA annually, but this is not a valuable tool to assess one's physical condition. Instead of spending 10-15 minutes for the PHA, which is treated as another annual requirement, then the Marine Corps could gain some value with this time that is already dedicated. The MO, IDC, or corpsman could use this time to conduct the FMS. According to Dr. Cook, the FMS takes 12 minutes to perform.[71]

Third, the HITT program offers a comprehensive training plan, but it is currently limited in its capacity. Using MCB Quantico as an example, an average of 165 Marines attended HITT classes per month from January to November 2015. An average of 94 Marines used the HITT facility during open gym hours in the same time period. There is 1 HITT coordinator and 8 full-time personal trainers who also serve as HITT Level 1 instructors. There are no mobile units at MCB Quantico, but units can schedule unit training at the HITT facility. Finally, there is a HITT train-the-trainer course offered once per quarter with a maximum of 25 seats per course.[72]

Unfortunately, HITT is not present at every installation, and there is a similar limitation across the USMC. Only 12 of 26 installations and only 24 of 69 gyms or fitness centers currently have these facilities.[73] During Fiscal Year 2015, 28,751 Marines used HITT facilities in some

capacity. These are not unique visits though since some Marines regularly use the facilities. There are 18 HITT coordinators and 34 support staff across all the installations. There is only one mobile unit, and there are 106 HITT lockers across all the installations.[74] The usage data shows Marines are interested in this program, but the majority of Marines simply could not use this as a primary means to conduct training due to the limited capacity and throughput.

There are three main counterarguments against changing the mentality of small unit leaders in their approach to physical training. First, Marines are currently physically fit, as measured by several metrics already discussed such as PFT scores, CFT scores, and BCP statistics. Also, professional military education (PME) institutions provide a model for a balanced physical fitness training session, and they give students ideas to take back to their units. Third, same as before, HITT is an available option for Marines to use.

While the acceptance of using PFT, CFT, and BCP statistics is common, the overall health of the Marine is what is lacking from those statistics. These statistics do not account for the total health and wellness. Secondly, PME schools do provide models for students, but in reality, how many Marines actually implement those new ideas once they return to their parent unit? Lastly, and as previously discussed, HITT is an option, but it is very limited in its capacity, particularly for unit training.

Physical therapy and functional movement screening used in a preventative manner would benefit Marines, but no program will be successful or effective without the individual Marine taking ownership and responsibility for his or her own health and well-being. Unit leaders can provide time for them to eat at the chow hall following unit training session, but they must actually go and make good choices. Unit leaders can allocate time in the schedule so Marines can reasonably get the recommended seven to nine hours of sleep per night, but again,

Marines must make choices and take advantage of that time.[75] While increasing force structure is a difficult proposition at this time, there are other ways to improve the fitness program. Units can use existing medical staff, or even Marines, with some minimal additional training, to perform the FMS. While this is not the ideal situation, it is an option. Also, engaged leadership, which does not cost additional money, is a key element to success of any program.

The 2012 Department of Defense document "Sustaining U.S. Global Leadership: Priorities for 21st Century Defense" states the most important military advantage the United States possesses is "the health and quality of the All-Volunteer Force."[76] If the USMC is to maintain the health of the force and enhance an already good fitness program, two things should occur. One is that the USMC should resource select units with physical therapists, or at a minimum, use the FMS. Second, small unit leaders should develop more comprehensive physical fitness plans that emphasize preventative measures. It is easy to use current fitness fads, such as high intensity interval training or CrossFit, or new technology, such as smartwatches and heart-rate monitors to measure biometric data, which have increased in popularity in recent years, but leaders within the institution can use more basic methods to increase performance and readiness. Leaders can emphasize prevention and develop comprehensive training plans without risking Marines' health to improve readiness and the overall health and wellness of Marines.

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