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ABSTRACT *(MAXIMUM 200 WORDS)*

Military fitness programs and fitness tests all contain a running component designed to train and measure the cardiovascular readiness of the individual. The inclusion of running starts in boot camps and is an expected standard of performance that is ultimately the individual's responsibility to maintain. To assist in this endeavor, each service branch provides varying levels of guidance to its personnel regarding how to train to meet these standards. In addition, unit leadership assigned selected personnel additional duties to conduct fitness tests and lead unit fitness formations, yet the amount of training provided on running is minimal and does not properly equip them with the skills necessary to recognize poor performances, nor how to correct them. The measurement of an individual's running performance equals the time it takes to complete the task, not how efficiently he or she completes the task. The individual's skill at performing the task is largely ignored, with the motivation of "managing the pain of running" going unchecked until the next fitness test. This study seeks to analyze how the military can best utilize medical and exercise studies and models of successful training programs to synergize and construct an effective military running program.

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MASTER OF MILITARY STUDIES

TITLE:

IMPROVING THE MILITARY'S RUNNING PROGRAMS
TO MINIMIZE INJURY POTENTIAL

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

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Executive Summary

Title: Efficient vs. Perfect Running: How running programs in the military can evolve to minimize injury potential.

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Thesis: Military fitness programs have failed to recognize running as a skill that can lead to minimized injury potential when properly instructed and evaluated in a continuous manner using established standards of efficient movement.

Discussion: Military fitness programs and fitness tests all contain a running component designed to train and measure the cardiovascular readiness of the individual. The inclusion of running starts in boot camps and is an expected standard of performance that is ultimately the individual's responsibility to maintain. To assist in this endeavor, each service branch provides varying levels of guidance to its personnel regarding how to train to meet these standards. In addition, unit leadership assigned selected personnel additional duties to conduct fitness tests and lead unit fitness formations, yet the amount of training provided on running is minimal and does not properly equip them with the skills necessary to recognize poor performances, nor how to correct them. The measurement of an individual's running performance equals the time it takes to complete the task, not how efficiently he or she completes the task. The individual's skill at performing the task is largely ignored, with the motivation of "managing the pain of running" going unchecked until the next fitness test. Individuals view footwear as the remedy to this pain, yet merely masks the underlying biomechanical issue that is the true reason for pain and injury. This study seeks to analyze how the military can best utilize medical and exercise studies and models of successful training programs to synergize and construct an effective military running program.

Conclusion: A running program that completely eliminates injuries is impossible to design, but restructuring them to treat running as a skill that requires solid guidance and consistent evaluation can minimize the possibility. While a perfect running technique does not exist, a program that emphasizes efficient technique will minimize overall injury potential.

DISCLAIMER

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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Preface

With over 14 years of experience in training, leading, and coaching running in the Air Force, I noticed the disparate direction and minimal guidance on how to run was in desperate need of evolution. Through careful study and self-experimentation, I found that prioritizing technique over volume and intensity when exercising led to not only optimized performance but also an extended period of non-injury. My belief is that this study will provide a solution that can contribute to both a lower propensity to running injuries and a higher degree of fitness and readiness required of military personnel.

Several people deserve thanks for assisting me in writing this paper. To Dr. Jonathan Phillips, thank you for seeing the spark in our initial conversation and supporting my enthusiasm in tackling this subject. Thanks for keeping the reins loose and allowing me to find my voice. To PJ Newton, thank you for sharing your vast knowledge and research on the subject of running, coaching, and fitness in general. We stand as a stellar example of how Marines and Airmen can work together and hopefully change the military for good! To the Leadership Communications Skills Center staff, thanks for taking the time to hone my rough ramblings of thought into a coherent, academic achievement. To my wife Gina, I am lucky to be called yours and I thank you for your unending love and support during this academic year, especially for smiling when I claimed I was “studying” with the PlayStation on.

Introduction

Each branch of the US military expects its personnel to maintain a certain degree of cardiovascular health as measured through tests of running performance. Assuming the individual is physically capable of running, this endurance component of fitness measures both health and readiness of the individual based on time, gender, and age on an annual or semi-annual basis. Unfortunately, military personnel receive poor training instruction on how to simultaneously train and reduce injury potential. Personnel with limited knowledge on physical training create poorly developed programs that do not take into account running technique. This lack of running technique accountability amplifies poor movement patterns, leading to short term injuries. If not properly addressed, these injuries grow into long-term issues where the individual feels he must "live with the pain" resulting in an ineffective path to improvement. At worst, these injuries can prevent the individual from mitigating negative impacts to deployment readiness status and personnel coordination processes throughout the force.

This paper suggests that the current military model addresses running as an assumed facet of physical performance rather than a skill that requires improvement and feedback. First, analysis of current military guidance reveals an ineffective training foundation built on a lack of standardized expectations and improperly trained personnel. Second, evaluation of medical and sports research highlights elements of training logic towards running programs that prove to reduce potential towards injury. Finally, these elements will be combined in a holistic running program with consistent feedback taught by qualified personnel that regards running as a skill as the proposed solution to train the US military properly.

The Joint Services Physical Training Injury Prevention Working Group reports that about 80 percent of lower extremity injuries for military personnel are due to excessive running volume

performed in training environments.[1] Molloy finds that mitigation efforts focused on sports and physical-training related injuries achieved the greatest reduction of lost duty days due to injuries across the DoD, and that a reasonable estimate for the DoD's annual cost related to musculoskeletal injuries is $100 million dollars.[2] Almeida et al. finds that 78% of injuries in Marine Corps basic training were due to overuse and significantly correlated to running and physical training.[3] Programs that prioritize (in order) volume, intensity, and technique have not efficiently prepared US military personnel to maintain fitness standards required of them. These types of programs force unprepared personnel into additional running volume without addressing poor running techniques. Furthermore, using different running shoes to ease running pain focuses on surface-level issues. Technique evaluation conducted on a recurring basis assists in reinforcing efficient habits as well as provides unbiased feedback based on individual abilities. Continuous evaluation of individual running performance must be against established standards of technique to reduce potential for injuries. Instituting a holistic running program taught by qualified personnel is the solution to reducing injury rates for the US military.

Running within current military fitness programs and guidance

Without a doubt, physical training and readiness are cornerstones to an effective military. The physical demands of military personnel require a body that can handle situations of warfare that vary in length, intensity, strength, and endurance. A commonality of measuring

[1] Joint Services Physical Training Injury Prevention Working Group, *Interventions evaluated to make recommendations for physical training related injury prevention; A Supplement to the Military Training Task Force White Paper: A Process for Setting Military Injury Prevention Priorities and Making Evidence-based Recommendations for Interventions,* May 2007, 18, http://www.med.navy.mil/sites/nmcphc/Documents/health-promotion-wellness/injury-violence-free-living/interventions-evaluated-to-make-recommendations-for-injury-prevention.pdf.

[2] Joseph Molloy, "Literature Review on Health Impacts of Running for Various Foot Types and Appropriate Shoe Characteristics to Address Recruits' Needs," October 6, 2014.

[3] S.A. Almeida, et al., "Epidemiological patterns of musculoskeletal injuries and physical training," *Medicine & Science in Sports & Exercise*, 1999, 176-1182.

cardiovascular/respiratory fitness across the services is the running component of the fitness test. Currently, the Marine Corps uses 800 meters and 3 mile distances to measure performance, the Army uses 2 miles, and the Air Force and Navy use 1.5 miles. Each service provides guidance on how individual performances based on time against these distances measures his or her physical readiness. Frequency of these performances also vary. The Marine Corps designates semi-annual tests in the spring and fall, and the Air Force designates a semi-annual tests if the individual score above or below a comprehensive fitness test score. In summary, US military services universally exalt the importance of maintaining physical readiness overall and provide procedural guidance to administer these tests, yet each service has a different method of addressing its respective running components.

The Navy provides the least amount of guidance in defining physical readiness for its personnel. Office of the Chief of Naval Operations 6110.1J, *Physical Readiness Program*, is mostly procedural in guidance. The beginning of the guidance document states, "It has become increasingly important for all Navy personnel to maintain a minimum prescribed level of physical fitness necessary for world-wide deployment, whenever or wherever needed."[4] The recommended frequency of activity is a combined two hours and 30 minutes per week, to include strength training exercises conducted at a minimum of twice per week.[5] The remainder of the instruction focuses on explaining actions and responsibilities of personnel throughout a unit for administering Physical Fitness Assessments. The Marine Corps guidance offers a similar timeframe of 2.5 hours per week combined with at least two strength sessions, yet goes on to provide further explanation on the importance of physical readiness. Marine Corps Order

[4] Chief of Naval Operations, *Physical Readiness Program,* OPNAVINST 6110.1J, July 11, 2011, 2, http://www.navyfitness.org/_uploads/docs/6110.1J.pdf?nc=940926155.

[5] Chief of Naval Operations, *Physical Readiness Program,* OPNAVINST 6110.1J, July 11, 2011, 3, http://www.navyfitness.org/_uploads/docs/6110.1J.pdf?nc=940926155.

6100.13, *Marine Corps Physical Fitness Program*, states, "As professional warrior-athletes, every Marine must be physically fit, regardless of age, grade, or duty assignment. Fitness is an essential component of Marine Corps combat readiness."[6] There is no mention of recommended running frequency or running technique to meet these physical readiness requirements. The Navy and Marine Corps leave knowledge and education of running within fitness programs at the discretion of the individual, providing a flexible yet potentially injury-laden level of responsibility on the individual.

The Air Force and Army provide similar verbiage explaining the importance of physical readiness to service personnel in addition to administering fitness assessments, yet also provide further details on how to prepare and execute running training sessions. Air Force guidance includes recommendations on frequency, duration, and intensity of physical activity. Air Force Instruction 36-2905, *Air Force Fitness Program*, states that individuals should "Accomplish moderately intense aerobic activity 30 minutes a day, five days a week or vigorously intense aerobic activity 20 minutes to 25 minutes a day, 3 days a week and muscle fitness exercise…or an equivalent combination of moderately and vigorously intense aerobic activity."[7] The instruction defines intensity as a perceived amount of exertion based on the individual's ability to hold a conversation.[8] Running is not stated as the specified aerobic activity for the individual to complete. Individuals may engage in alternate aerobic activities, such as using the elliptical machine or swimming, as positive options due to the low impact on joints, yet both of these activities are not part of the Air Force fitness assessment. If individuals train in these alternative

[6] Commandant of the Marine Corps, *Marine Corps Physical Fitness Program*, MCO 6100.13, August 1, 2008, 8. http://www.marines.mil/Portals/59/Publications/MCO%206100.13%20W_CH%201.pdf.

[7] Secretary of the Air Force, *Fitness Program*, AFI 36-2905, October 29, 2013, 61. http://www.afpc.af.mil/shared/media/document/AFD-131018-072.pdf.

[8] Ibid, 62.

cardio activities and avoid running until they run as part of their test, injuries are more prone to arise due to improper conditioning of the body to movements specific to running.

Only the Army provides running technique guidance in addition to the responsibility and procedural guidance as given by the other services. Army Field Manual (FM) 7-22, *Army Physical Readiness Training*, emphasizes to "Train the Fundamentals First."[9] FM 7-22 outlines a comprehensive guidance to the service on the importance of physical readiness to the soldier, how to address physical readiness from any given level of fitness, post-injury recovery plans, and detailed workout plans with accompanying exercise examples. FM 7-22 discusses the difference between aerobic and anaerobic systems, which directly links to the importance of having the endurance and speed to move under direct and indirect fire.[10] FM 7-22 does provide form recommendations of the head, arms, legs, and feet to yield an optimal running form (figure 1), yet also states that any attempt to force soldiers to conform to one standard may do more harm than good.[11]

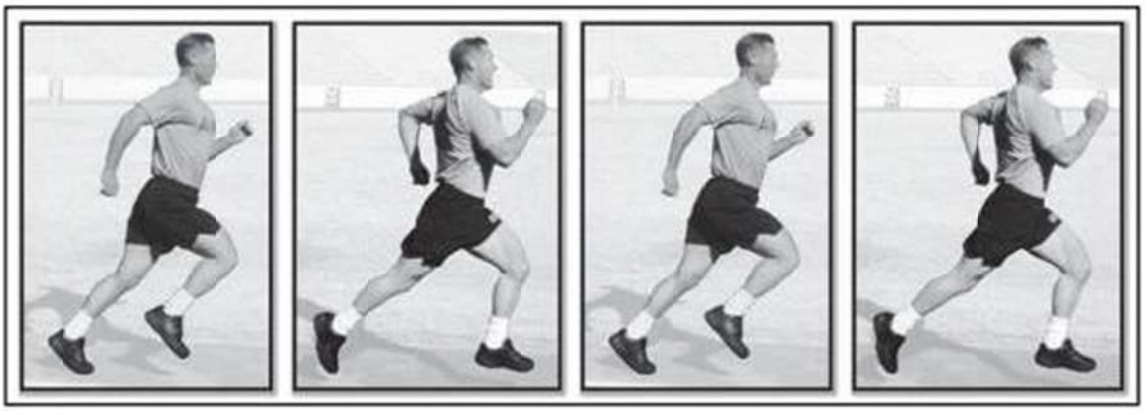

Figure 1. Army's sustained running form example.
Source: USA FM 7-22, 2012, 10-1.

[9] Secretary of the Army, *Army Physical Readiness Training*, FM 7-22, October 26, 2012, 1-3. http://armypubs.army.mil/doctrine/DR_pubs/dr_a/pdf/fm7_22.pdf.
[10] Ibid, 10-1.
[11] Ibid, 10-5.

The belief in the danger of modifying inherent running technique to the individual does not invalidate the possibility that there can be an efficient form for running that positively combines performance, efficiency, and injury prevention. While the Army provides the most guidance of the services when it comes to running technique, there is still room for improvements. These programs place heavy emphasis on only measuring timed running performances on an annual or semi-annual basis, not running technique as an activity that requires consistent attention. Considered within that narrow aspect, running technique is an assumed skill of the individual and not considered important. If the scope of US military fitness programs expands to include injury prevention and relation to deployment readiness, running technique and form must properly align with the mobility demands of US military personnel.

The dangers of creating a "black hole" of running experts

Several positions charged within the military include the responsibility of providing individual training advice and executing unit training programs for running, but these positions are undergoing changes that may leave the service with the potential of increased running injury rates. The Air Force implements a program that carries the most depth amongst the services and will be the focus of further analysis. One key position is the Exercise Physiologist (EP), who works in Health and Wellness Centers and are usually co-located with the fitness center. EPs are medically trained and certified to oversee the analysis, improvement, and maintenance of health and fitness of individuals. The other position is the unit Physical Training Leader (PTL), an additional duty appointed by the unit commander that carries various responsibilities. Airmen seek running advice from EPs to improve their running performance based on their training and professional background. The most common solution provided is a running program intended to improve the individual's 1.5 mile run performance through a standardized 4-6 week running

plan. This plan purposefully minimizes overtraining allowing the individual to peak in performance on test day, yet the decentralized execution of the program prevents the EP from giving real-time feedback to the individual. If the program calls for 800 meter repeats, the individual is expected to complete the workout as designed regardless of how his body is responding to the exertion required. In addition to providing running advice, EP responsibilities also include administering PTL training programs that follow Air Force-standardized curriculum. Due to budget constraints the EP position has been cut and both services of providing running counseling and PTL training will transform to mitigate a gap in service.[12]

The A1 (personnel, manpower, and services) community will provide running advice once given by EPs from within the medical community, but in a more general method instead of individualized. Centrally developed programs by the A1 community, such as Operational Fitness[13] and Fit For Duty,[14] offer a cost-effective method of providing on-demand fitness counseling and workout routines. These programs are not directive in nature, but rather optional tools that PTLs or individuals themselves can use at their discretion. Of important note is neither of these programs offers any advice on running, but general strength and conditioning routines instead. The problem with this model is that the 3MOX1 Air Force Specialty Code, synonymous with Military Operating Specialties from sister services, is responsible for a wide range of services that include hotel, restaurant, and fitness center and equipment management.[15] These centrally designed programs are available within fitness centers, but if an individual has any

[12] John Oh, "Air Force Health Promotion Wayahead" (communication guidance card, Air Force Medical Support Agency, April 18, 2014).

[13] "Operational Fitness," *My Air Force Life*, last accessed November 21, 2014, https://www.usafservices.com/portals/0/uploads/OperationalFitness/OperationalFitness.pdf

[14] "Fit For Duty," *DoD News*, last accessed November 22, 2014, http://dodnews.defense.gov/Shows/FitforDuty.aspx

[15] Headquarters US Air Force, *3M0X1 Career Field Education and Training Plan*, June 21, 2012, 9. http://static.e-publishing.af.mil/production/1/af_a1/publication/cfetp3m0x1/cfetp3m0x1.pdf

questions about the programs he will naturally seek out personnel that work within the fitness center for additional information. Fitness center personnel do not receive training in the same manner as EPs, but because they work within the fitness center they could be perceived as fitness "experts". Since running is not covered in the program material, fitness center personnel may attempt to fill in the knowledge gap and offer unqualified training advice. In an interview with Colonel John Oh, Chief of Health Promotion, AFSMA, this "black hole" of knowledge within the fitness center could lead to increased injury rates. Colonel Oh states:

> The cultural shift of responsibility for providing advice and guidance on exercise routines from EPs to A1 personnel will be difficult, especially considering the A1 personnel come from diverse duty backgrounds that may or may not provide a consistent level of expertise expected by airmen who visit the fitness center for guidance. There is no guarantee the A1 personnel have any proper qualification to provide guidance to a member asking for running advice that will balance performance with injury prevention.[16]

Pushing a training system forward that provides advice from unqualified personnel is unnecessary and can easily lead to increased injury rates. PTLs are treated as "qualified personnel" in the subject of physical fitness, yet analysis of the training they receive divulges inadequacies.

PTLs hold two primary responsibilities, which include properly administering fitness tests and leading unit fitness formations. The method on how PTLs will receive their training will transition from an interactive course taught by the EP to an online training module to stay aligned with Air Force requirements. Unfortunately, online training programs often lack the depth of personal interaction necessary to engage the person fully in training. With a subject as broad as fitness, there is a large potential for error where the person receiving the training may or may not understand all of the information presented to him. Moreover, attendance to PTL

[16] Colonel John Oh (Chief, Health Promotion, Air Force Medical Support Agency), interview by Gabriel Avilla, Alexandria, VA, October 10, 2014.

training is the only requirement to earn the qualification of the position. Comprehension of information through a test or evaluation of someone performing physical activities is not included to confirm the individual is properly prepared to supervise or conduct fitness activities. Although cost effective, the removal of personal interaction from PTL training results does not guarantee understanding of the subject and will ultimately yield a moderately prepared workforce.

Within the currently available PTL training curriculum, Progression, Frequency, Intensity, Time, and Type are emphasized factors PTLs must consider when designing fitness programs for the unit.[17] The curriculum recommends these principles so that PTLs lead unit fitness formations that take into account individual physical abilities and not unsafely extend past them at the expense of the group activity. To simplify these principles for further discussion, Volume summarizes the principles of Progression and Frequency, in that PTLs should recognize that individuals differ in their ability to safely complete differing levels of distance within singular or cumulative fitness sessions. Intensity bundles together the principles of Time and Type, meaning PTLs program optimal fitness formations through variation in the level of efforts of physical activities using perceived and/or actual heart rate exertion. The training material goes on to state, "For improvement to occur in a safe and injury-free manner, [PTLs] must scale the initial load and intensity equal to the individual's current level of fitness."[18] Again, Volume and Intensity are directed heavily as the factors the PTL must take into consideration when advising and designing fitness protocols. The component missing to this fitness program is Technique, or the ability for an individual to perform physical activity in the most efficient manner. Scaling, or modifying movements to match the physical limitations of the individual, is

[17] U.S. Department of the Air Force, *Air Force PTL Training Slides*, January 1, 2011, Slide 24.

[18] Ibid, Slide 27.

bundled under the training element of Intensity and considered a positive attempt that properly addresses technique. The PTL training curriculum addresses running form, but only in text form and without visual support. PTLs are not properly trained or tested on how to identify deviations to technique because technique is not taught to them. How can running workouts be properly scaled by the PTL as directed by the training if the PTL is unable to verify proper and improper movement? If scaling is directed as the process of ensuring injury-free training, it must take into account all of the individual's capabilities, which must include a defined method of Technique in addition to Intensity and Volume. If technique can be defined by the services for fitness tests components such as push-ups, sit-ups, and pull-ups, why is running not treated the same? The issue of educating individuals and fitness leaders to practice efficient running technique is not unique to the military, but the military can gain insight from outside agencies on how to improve its programs. The first step in the direction of improvement will be to define what efficient running technique actually means.

The medical community's civil war on running technique

Medical research and studies offer perspective into the division on how communities correlate running and injuries. Due to the popularity of the sport, numerous studies seek to answer questions regarding training, form, shoes, and technique to assist new and experienced runners on what running myths and theories to believe and not believe. To understand what running advice would best serve military personnel to optimize readiness, one must look for recurring themes that point to certain performance techniques that shape the most efficient method of running while reducing overall injury rates. Disparate information found through research should synergize to build proper and standardized training materials for military personnel to use within their personal or unit training protocols. Byrne states, "No universal

running form is perfect for everyone, but training protocols can be individualized and promote certain patterns that reduce injuries...By improving efficiency of motion, I believe we are also reducing injury risk."[19] This perspective offers an ideal solution for optimized running program that takes into account individual performance and capabilities. Edwards further argues that biomechanics will learn to accommodate individual running form, even if it's technically the wrong way to run, and that no ideal running form exists.[20] While a *perfect* running form that can be applicable to everyone may not exist, certain running techniques can combine to produce an *efficient* form that minimizes running injury potential and increases running performance.

When discussing running technique, addressing first how the foot makes contact with the ground is critical. Medical research exists that can provide insight on which method of foot striking should be avoided due to the potential lead to more injuries. The most common misconception is that rear foot striking (RFS), commonly known as "heel striking", is natural and has no negative effect on running. Chan and Rudins finds that approximately 80% of runners land with their heels striking the ground first.[21] The primary issue of RFS is the associated Ground Reaction Force (GRF), or how the body absorbs the impact of each step made while running, and Vertical Impact Force (VIF), or the transfer of energy vertically through the body. Hrejlac states that GRF is the only external force that is likely to contribute to running injuries.[22] Cavanagh and LaFortune finds that RFS runners generated higher amounts of GRF when

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[19] Mick Byrne, "On The Run: A Coach's Perspective," *Journal of Orthopaedic & Sports Physical Therapy, Volume 44, Issue 10*, October 2014, 730.

[20] Sally Edwards, Carl Foster, and Yor M. Wallack, *Be A Better Runner*, Fair Winds Press, Beverly, MA. 2011, 143-145.

[21] C.W. Chan and A. Rudins, "Foot Biomechanics during walking and running," *Mayo Clinic Proceedings, Issue 69*, 1994, 448-461.

[22] Alan Hreljac, "Etiology, Prevention, and Early Intervention of Overuse Injuries in Runners: a Biomechanical Perspective," *Physical Medicine and Rehabilitation Clinics of North America,* 2005, 653.

compared to Forefoot Striking (FFS).[23] In-depth research has not proven a direct correlation of RFS or a higher GRF as the de facto characteristics that determine running injuries, but logic exists proving that by seeking to reduce the overall amount of GRF created when running, injuries can be minimized.

FFS is an alternative running style to RFS, where the middle or forefoot portion of the foot makes ground contact first instead of the heel. Diebal found that altering running mechanics by adopting FFS running as opposed to RFS may assist in the treatment of Chronic Exertional Compartment Syndrome, specifically with anterior compartment symptoms.[24] Hreljac also finds that runners who have developed stride patterns that incorporate relatively low levels of impact forces and a moderately rapid rate of pronation are at a reduced risk for incurring overuse running injuries.[25] The Pose Method of running, developed by Dr. Nicholas Romanov, is a popular system of running that emphasizes FFS over RFS. Regan et al. found that the FFS strike pattern emphasized in the Pose Method will yield lower vertical impact forces compared to RFS strike patterns.[26] Kulmala et al. also finds that runners who utilized FFS lowered their patellofemoral joint stress, commonly known as "runner's knee", by 14.6% compared to RFS.[27] Additionally, Arendse et al. finds that the runners who utilized FFS as included in the Pose

[23] P. R. Cavanagh and M. LaFortune, "Ground Reaction Forces in Distance Running", Journal of Biomechanics, Issue 13, 1980, 397-406.

[24] Angela Diebal, Robert Gregory, Curtis Alitz, and J. Parry Gerber, "Effects of Forefoot Running on Chronic Exertional Compartment Syndrome: A Case Series," *The International Journal of Sports Physical Therapy, Volume 6, Issue 4*, December 2011, 312.

[25] Alan Hreljac, "Impact and overuse injuries in runners", *Medical & Science in Sports & Exercise*, 2004, 36, 845-849.

[26] Arendse E. Regan, et al., "Reduced Eccentric Loading of the Knee with the Pose Running Method", *Medicine & Science in Sports & Exercise, American College of Sports Medicine,* 2004. 375.

[27] J.P. Kulmala, J. Avela, K. Pasanen, and J. Parkkari, "Forefoot strikers exhibit lower running-induced knee loading than rearfoot strikers", *Medicine & Science in Sports & Exercise*, 2013, 2306-2313.

Method reduced eccentric loading at their knees.[28] The less loading at the knee, the less likely runners will accumulate pain or injuries. Military personnel would benefit from this research by adopting the standardized understanding that FFS is the optimal choice over RFS due to the lower risk of injury potential. However, this running technique is not the singular solution to an ideal running form, but a component of a larger solution set.

In addition to running foot strike patterns aimed at reducing loads on the body, stride length presents another opportunity to build efficient running technique. Stride length is considered as the distance between alternating foot strikes while running. Derrick et al. finds that the knee joint absorbed the most force during RFS running and that this force also increased when stride length increased.[29] RFS and longer stride lengths often correlate together, resulting in an increase risk to injury. When a runner utilizes long stride length heel strikes on one foot, the runner must extend his opposite leg with a corresponding long stride, which results in heel striking again with his foot in front of his center of mass. Most runners are not aware of this movement pattern and increase in impact force on their knees, and they equate longer strides and heel striking to the belief of running faster. Subsequently, an overall increase in the number of running steps, or developing a higher stride count over a set metric of time, will also reduce the distance of stride lengths. Derrick et al. further finds that even with a higher number of ground contacts due to a higher stride count, the overall reduced magnitude of loading on the body outweighs any potential detriment.[30] Heiderschiet et al. also determines that "Subtle increases in step rate can substantially reduce the loading to the hip and knee joints during running and may

[28] Regan, et al., 375.

[29] T.R. Derrick, J. Hamill, and G.E. Caldwell, "Energy absorption of impacts during running at various stride lengths," *Medicine & Science in Sports & Exercise, Issue 30,* 1997, 135.

[30] Ibid, 135.

prove beneficial in the prevention and treatment of common running-related injuries."[31] Reduced stride length and increased stride count are two complementary components to FFS that continue to build an efficient running form.

The Pose Method of running incorporates these best practices of running (FFS, shorter stride length, and higher stride count) into a comprehensive curriculum that explains the ideal form of running that can result in lower risk of injury. The Pose Method differs from traditional running forms by teaching runners to fall forwards utilizing gravitational torque while pulling the support foot rapidly from the ground using the hamstring muscles.[32] The Pose Method explains that all runners regardless of skill or speed pass through three "poses" of movement while obeying the laws of gravity (figure 2).

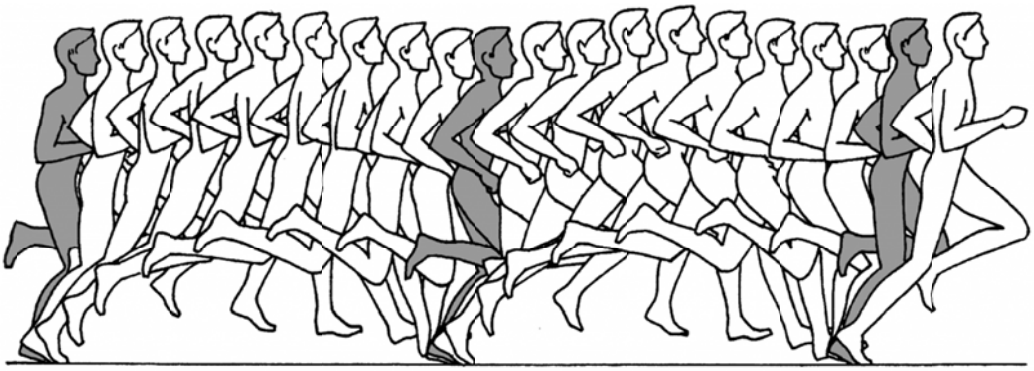

Figure 2. Runner passing through three "poses" of movement.
Source: "What is Pose Method?", Romanov Academy of Sports Science, https://posemethod.com/pose-method/.

By learning the most efficient methods to transition between these poses, runners can take advantage of gravity and reduce the amount of force placed on the body and reduce injury potential. Even more valuable is the ability for individuals to be visually evaluated against the

[31] Bryan Heiderscheit, Elizabeth Chumanov, Max Michalski, Christa Wille, and Michael B. Ryan, "Effects of Step Rate Manipulation on Joint Mechanics during Running," *Journal of American College of Sports Medicine*, 2011, 296-302.

[32] Nicholas Romanov and Graham Fletcher, "Runners do not push off the ground but fall forwards via a gravitational torque," *Sports Biomechanics, Volume 6, Issue 3, September 2007*, 434-452.

standard of these poses. Evaluation using the Pose Method of running includes the following a six-point running analysis:

1. Initial Contact
2. Trail Leg
3. Frame Count
4. Running Pose
5. Fall Angle
6. Pull Timing

This evaluation provides specific feedback to the individual on his or her running technique that focuses attention on both positive and negative traits of performance that contribute to injury avoidance. Studies remain critical of the Pose Method and its claim for reduced loading. Regan et al. finds that runners using the Pose Method had a greater power absorption and eccentric work at the ankle when compared to RFS runners.[33] Dr. Romanov addresses this concern by replying that the transfer of energy from the knee to the ankle, Achilles tendon, and calf muscles is the preferred situation due to those body parts being able to absorb energy during running better than cartilage and tendons within the knee.[34] Two objects colliding, such as a runner's foot and the ground, will always produce force between them. The issue of debate is how to manage this production of force that yields the least amount of injury to the individual, and Dr. Romanov's research provides a model of running that can be applied in an effective training program that provides objective feedback. Consistent pounding on the knee joint through inefficient technique leads to greater risk for injury, and applying Dr. Romanov's Pose Method can deliver a revolutionary perspective and positive change on military running programs.

[33] Regan, et al., 375.

[34] "How to Run Faster, Farther, and Injury Free for Life w/ Dr. Nicholas Romanov," video, posted by Barbell Shrugged, November 4, 2014, https://www.youtube.com/watch?v=5OYs9UiFWOg&list=UUSnnzcYG3QbW7kJjz915JmQ.

Shoes: the popular band-aid to runner's injuries

While running technique receives mixed reviews on positively contributing to minimizing running injuries, running shoe selection is commonly seen as the easiest solution, and the military is not an exception to this belief. Air Force PTL training promotes the popular concept that runners fall into certain categories based on the runner's foot arch type and expected pronation, thus leading to a certain foot strike pattern.[35] Knapik determines that selecting running shoes based on arch height had little influence on injury risk on military basic training,[36] yet this has not slowed down the perception that shoes are the solution to preventing running injuries. Three categories of running shoes, commonly known as Lightweight, Neutral + Cushioning, and Stability (figure 3), are marketed as designs to address these common tendencies to lead the runner to the believe that he or she is pre-determined to a running shoe type that takes into account his or her individual running style.

[35] U.S. Department of the Air Force, *Air Force PTL Training Slides*, January 1, 2011, Slides 96-103.

[36] Joseph Knapik, Daniel Trone, Juste Tchandja, and Bruce Jones, "Injury-Reduction Effectiveness of Prescribing Running Shoes on the Basis of Foot Arch Height: Summary of Military Investigations," *Journal of Orthopaedic & Sports Physical Therapy, Volume 44, Issue 10*, October 2014, 805.

Figure 3. Typical running shoe categories.

Not surprisingly, shoe companies also actively promote this method of thinking by continuing to offer new technologies to advance each category. Bachman reported that every innovation designed to reduce injury rates have a big impact in the $3.1 billion dollar running-shoe industry.[37] Pigeonholing runners into one of three categories of running shoes that address the individual's running style may seem helpful, but the inverse relationship proves more accurate than otherwise. The American Academy of Orthopaedic Surgeons released information claiming shoes with cushioned heels promote a heel-strike running pattern, whereas runners with track flats and barefoot had a forefoot or midfoot strike pattern.[38] Novacek also determines, "Despite advances in shoewear technology, the overall rate of injury in distance runners has not changed significantly. This lends credence to the concept that chronic injury patterns are due to

[37] Rachael Bachman, "Better Than Barefoot: Running Shoes Seek Middle Ground," *Wall Street Journal*, July 23, 2014. http://online.wsj.com/public/resources/documents/print/WSJ_-D001-20140723.pdf.

[38] American Academy of Orthopedic Surgeons, *Cushioned Heel Running Shoes May Alter Adolescent Biomechanics*, March 19, 2013, http://newsroom.aaos.org/media-resources/Press-releases/cushioned-heel-running-shoes-may-alter-adolescent-biomechanics.htm.

factors other than the forces generated by the shock of initial contact and foot alignment in stance." [39] Therefore, the belief in reducing running injuries through shoe selection masks the true issue of poor movement mechanics. Vincent and Vincent support the claim that "Running shoes should protect the feet from injury, but not provide excessive cushioning and lots of extra support in the arch...High, thick cushioning may actually encourage runners to adopt worse biomechanics and land with greater impact than shoes with less cushioning."[40] Instead of looking at shoes as the fastest solution in preventing running injuries, running form and technique would be the more appropriate area of interest that can serve as the optimal foundation to a well-rounded running education and training program for the military.

Maintenance Prevention versus Injury Treatment

Since most personnel enter the military with at least 18 years of believing they already know how to run, relearning how to run efficiently can be challenging. The benefits of relearning how to run efficiently are worth the reduction to injury potential. Warden et al. states "...a history of repeat [bone stress injury] and the accumulating loss of running time are signs that gait retraining should be considered...If injuries due to running are properly documented, this information can be extrapolated to poor running form and should be addressed accordingly."[41] Unfortunately, tracing poor running technique as the specific reason for running injuries within the military is not accurately conducted, thus making it difficult to have sufficient evidence necessary to drive mass changes to military training programs. Roy et al. found that

[39] T. F. Novachek,"The Biomechanics of Running," *Gait and Posture, Issue 7,* 1998. 92.

[40] Heather K. Vincent and Kevin R. Vincent, "ACSM Information On Selecting Running Shoes," *American College of Sports Medicine,* 2014. http://www.acsm.org/docs/brochures/running-shoes.pdf.

[41] Stuart Warden, Irene Davis, and Michael Frederickson, "Management and Prevention of Bone Stress Injuries in Long-Distance Runners," *Journal of Orthopaedic & Sports Physical Therapy, Volume 44, Issue 10,* October 2014, 749.

current DoD injury surveillance databases lack uniformity in metrics collected and data entered.[42] A pilot project to document this level of detail is recommended to provide evidence which can drive positive change to military running programs.

The premise of an effective military running program must be more of a proactive, preventative maintenance program instead of a reactive, injury treatment program. When a person reports pain or an injury associated with running, it is too late to effectively treat the core of the problem. Medical professionals commonly treat the symptom of the pain as opposed to the reason for the pain. Reduced running volume, substituting non-impact exercises such as elliptical or swimming, or stopping running altogether are common treatment solutions. While these options assist the individual in reducing stress on the body, they do not sufficiently address the underlying issue: understanding and correcting poor body movement through a holistic training program.

Running is a skill, not an assumed method of movement

The running industry has evolved to embrace these new ideas on running and provides insight to how military personnel have taken the initiative to improve their technique. CrossFit Endurance (CFE) seminars are two-day seminars that advocates Dr. Romanov's Pose Method and assesses and corrects the mechanics of an athlete's running technique; applies CFE-prioritized principles of Technique, Intensity, and Volume that are necessary to coach or perform successfully; and integrates additional factors (e.g., nutrition, mechanics) into training programs that help individuals achieve new performance standards.[43] Upon completion of the seminar, attendees receive a six-week progression program designed to improve their running technique

[42] Tanya Roy, Barbara Springer, Vanceil McNulty, and Nikki Butler, "Physical Fitness", *Military Medicine, Volume 175, August Supplment, 2010*, 18.

[43] "CrossFit Endurance Trainer Seminar Overview", https://training.crossfit.com/endurance-trainer.

and performance gradually. Founded by Brian Mackenzie, CFE differs from traditional running programs that prioritize the principles of Volume, Intensity, and Technique. Instead, CFE reverses the order and prioritizes Technique, Intensity, and Volume.[44] This method forces the athlete to understand the importance of Technique based on a measurable standard before adding running volume. CFE programs combine these running principles of training with the strength and conditioning program of CrossFit, which promotes a comprehensive approach to physical fitness training that includes "constantly varied, functional movements performed at high intensity."[45] With Technique held as the priority within overall principles of physical fitness training, military running programs can mature into excelling industry models that fully embrace this concept.

CFE seminars have already attracted military personnel looking to relearn how to run efficiently, averaging between 18-24 attendees per month according to PJ Newton, Director of Training at CFE. The program uses and teaches the Pose Method as the standard for running form, but Newton also states that although individual running technique can be slightly improved over the course of the weekend seminar, that doesn't mean the newly gained knowledge will stick. Newton states that most military attendees pay for their seminars out of pocket and want to seek improvement from the lack of quality training/coaching offered from their military units and fitness center staff. He goes on to state, "When you talk about learning any new skill, or motor control pattern, it takes a ton of practice and the discipline to continue to do the drills, dial back the intensity, and really focus on moving well."[46] Retaining knowledge of efficient running

[44] Brian Mackenzie and Glen Cordoza, *Power, Speed, Endurance*, Victory Belt Publishing, 2012, 15.

[45] Greg Glassman, "Understanding CrossFit," *CrossFit Journal, Issue 56*, April 2007.

[46] PJ Newton (Director of Training, CrossFit Endurance), interview by Gabriel Avilla, Alexandria, VA, November 25, 2014.

form is not a one-time task, but rather learned through a continuous spectrum of data-driven information, objective observation, and consistent practice to gain the full positive effect.

Providing consistent feedback and organizing experts

An important improvement the military should incorporate into its running program is the addition of an annual analysis of individual running technique. Roy et al. states that "An adequate surveillance system monitors injury incidence and allows injury to be tied to mechanisms of injury."[47] Again, running technique should not be viewed as a one-time training event but a long-term program that requires consistent, non-biased feedback. This analysis can be conducted via video technology to observe the individual's full-body running technique instead of limiting the study to gait analysis (figure 4).

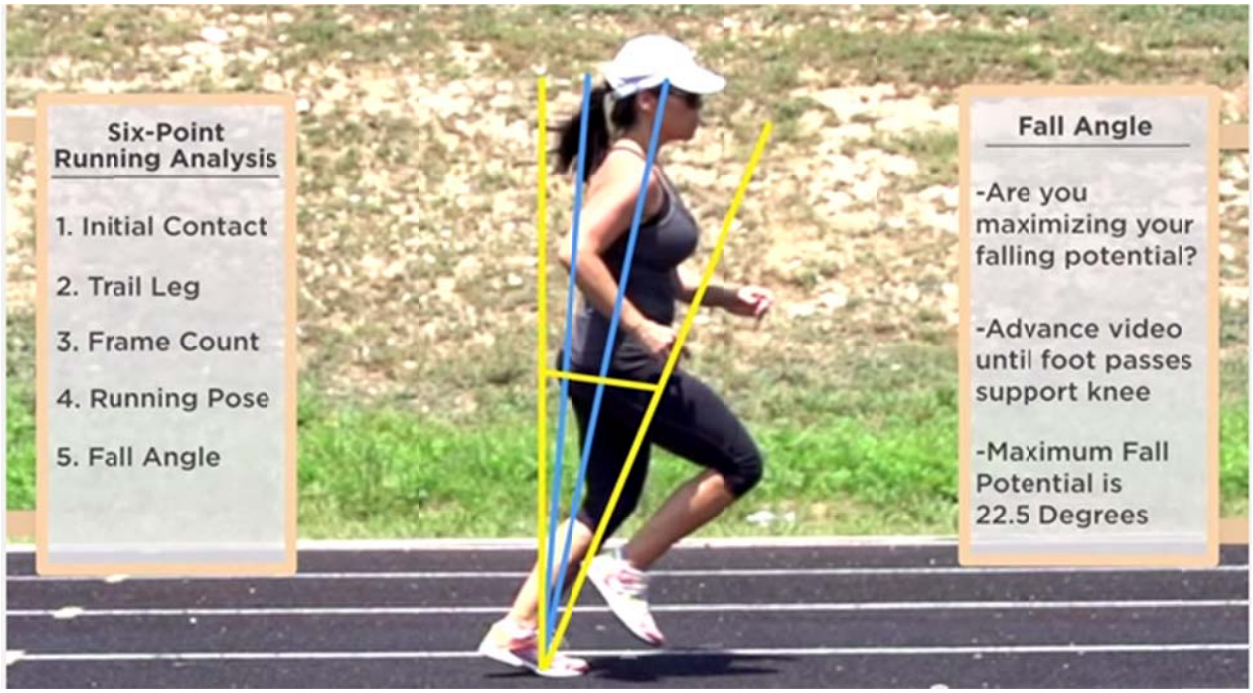

Figure 4. Running form video analysis screenshot.

[47] Tanya Roy, Barbara Springer, Vanceil McNulty, and Nikki Butler, "Physical Fitness," *Military Medicine, Volume 175, August Supplement, 2010*,17-18.

Source: "4-3: Six Point Running Analysis" video, 2:05, posted by posetv, November 5, 2013, https://www.youtube.com/watch?v=7jLD2rfRPDQ.

By videotaping individuals from a side angle and analyzing full-body positioning and movement using the Pose Method six-point analysis as the standard, deviations from the standard can be corrected with specific running drills and exercises tailored for the individual. Running analysis should be conducted once a year at minimum, but separated from the annual or semi-annual physical fitness test. Synchronizing with the individual's annual physical exam may offer an optimal opportunity, in that the individual's health and movement patterns can be analyzed for a holistic analysis.

In order to ensure properly trained personnel conduct quality analysis, a tiered system of running-specific experts can be developed within the military to provide this service. One system that offers an effective model of qualified instructors that can be replicated is the Marine Corps Martial Arts Program (MCMAP). MCMAP differs from PTL training in that tiered levels of knowledge, expertise, and demonstration of physical abilities are requirements to become a Martial Arts Instructor Trainer (MAIT). MAITs must complete a seven-week course that enhances their knowledge of MCMAP principles as well as how to conduct individual and unit training sessions.[48] In addition, MCMAP offers a belt ranking system that recognizes individuals who demonstrate proper martial arts techniques.[49] This same model can be applied to a running program where military personnel are trained on CFE and Pose Method protocols and must earn and maintain tiered levels of expertise. This decentralized approach of developing subject matter

[48] Commandant of the Marine Corps, MCRP 3-02B, *Marine Corps Martial Arts Program*, 1-4.

[49] Ibid, 1-4.

experts on running technique can be less expensive than bringing back full-time EPs, yet provide a similar level of qualified advice. Each tier would carry an increased level of responsibility based on a demonstrated understanding of efficient running techniques and the ability to analyze individual running form. These trained personnel would carry this training qualification for as long as they are able to properly demonstrate an understanding of the program and may serve in leadership roles within their units where they would be responsible for instructing and analyzing running technique. Periodic testing of running technique knowledge will solidify the skillsets of these trainers, ensuring the designated workforce remains qualified to perform evaluations. This incentivizes the system of training for the individual through additional leadership opportunities across all ranks and provides a properly educated team of personnel who are able to train others through a standardized program. By creating running-specific experts internally, the US military will be able to consistently enforce service fitness standards regardless of changes to operational tempo.

Conclusion

As military equipment must evolve to meet a dynamic security environment, so should the approach to building and executing an effective running program aim to optimize the military's most valuable asset: personnel. There is no way to eliminate injuries from running completely, but incorporating standardized and efficient training principles is the optimal solution to this issue. The conduction of research will continue to both support and negate claims to a perfect running technique, but there is major value to be gained through streamlining the perspective of using the most efficient running technique that reduces injury potential. Injury databases need to be enhanced to include pertinent data that can assist in pinpointing negative trends so that they can be mitigated. Additionally, research must be completed to shed light on

the analysis of comparing military personnel trained on evaluating running technique to bringing back exercise physiologists to determine the optimal return on investment. Military personnel must walk the line of maintaining high levels of physical readiness yet not becoming injured, and the opportunity to positively shape the pathway to this goal can take advantage of industry-proven training principles such as the Pose Method and CFE. Properly educating and training subject matter experts on running will enhance this opportunity by creating a qualified workforce able to provide consistent guidance and advice on running efficiently and enforce military fitness standards. Finally, viewing this opportunity as a continuous effort to develop a running culture based on maintenance prevention instead of injury treatment will lead to overall reduction in DoD healthcare costs. Military running training programs must evolve to maintain an efficient edge in performance, and this is the step in the right direction.

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