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TITLE: Combating Degenerative Spinal Health in Marine Corps Aviation:
Preserving the Force by Bringing Preventative Health Care Directly to the Aviator

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*Combating Degenerative Spinal Health in Marine Corps Aviation:
Preserving the Force by Bringing Preventative Health Care Directly to the Aviator*

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Abstract

This thesis investigates the problem of degenerative spinal health that is rampant within the United States Marine Corps rotary wing community. These injuries result in a lower post-career quality of life and exorbitant medical care costs. Several causal factors which will be examined, combine with a culture that discourages and a work environment that impedes obtaining preventative and restorative healthcare. This has resulted in a community where up to 85% are suffering from back pain and a reported 60% either will not or cannot seek treatment.¹ This thesis will not argue for the requirement to address poor cockpit ergonomics or the requirement for flight equipment modernization. While they are valid arguments, the intent here is to paint the picture as it exists and describe the negative impacts these factors have on an aviators' spinal health through prolonged exposure to their flight related duties. The proven long-term health and cost benefits of applied chiropractic care in the prevention of chronic musculoskeletal disorders will be discussed. This, combined with similar benefits associated with the implementation of mobile healthcare, will form the solution to this thesis' problem. Mobile chiropractic units that can deliver preventative and restorative chiropractic care directly to USMC helicopter squadrons will have a profound effect on force preservation and unit readiness. If implemented, they could help save millions of dollars spent on training replacement aircrew along with veteran disability compensation and healthcare costs. Taking care of veterans requires changing the approach in which they are cared for during their career.

I. Introduction

A. Background

According to the United States Department for Veterans Affairs, “Health Care and/or Disability Compensation accounted for 76% of all Veterans Administration (VA) use in FY 2016, up from 68% in FY 2007.”² One *Washington Times* article reported that “The VA provides \$63.7 billion in compensation annually to about 4.1 million veterans living with disabling conditions suffered during military service.”³ Compared to the \$30 billion spent in the same category in 2006, as reported by the Department for Veterans Affairs, the expense has more than doubled over the last decade. As the utilization of VA health care and disability increase, the same is true for the costs associated with caring for America’s veterans. One of President Donald Trump’s campaign promises was to ensure America’s veterans would be provided with the care and benefits they have earned through their service. Even with approved legislation, and budget increases aimed at taking care of America’s veterans, it is important to address preventative health care improvements for active duty service members. Proactive healthcare can prevent acute injuries from becoming chronic over time. These measures will in turn, improve readiness and performance during active duty and improve quality of life as a veteran. This paper will concentrate on United States Marine Corps rotary wing pilots and aircrew and the negative effects flight related duties have on the spinal health of this community. The wear and tear accrued on the necks and backs of these Marines can be attributed to many causal factors, but the primary focus will include posture as a result of cockpit ergonomics, issued flight gear, and increased exposure due to operational tempo. Ongoing preventative and rehabilitative orthopedic care is not easily accessible to Marines within this community given

today's operational tempo and often only comes at the expense of time to train. Facilities specializing in sports medicine and chiropractic care are often far from the Marines place of work if available at all. This results in the accumulation of aches and pains that go untreated over the Marines service life that can manifest into more severe long term degenerative spinal disease. After a Marines career, high percentages of disability result in monthly pay-outs of compensation, costly surgeries, medication, and an overall lower quality of life as a veteran. The introduction of mobile health units providing chiropractic care directly to USMC squadrons could effectively prolong the service life of USMC rotary wing aircrew, improve their health during and after their careers, all while increasing unit readiness and decreasing the long-term cost to the American taxpayer through lower post-career disability compensation and health care requirements.

B. Ergonomic Design

Ergonomics, or the study of human efficiencies in their working environment, has a very practical application in aircraft design. Having a solid grasp on how a human will interface with their system or machine is critical for an engineer when designing the cockpit of a helicopter. Design characteristics within the seat and cushion affect sitting posture. The proximity of control surfaces and systems that need to be manipulated by the pilot will change the body position and alignment of the spine. Un-dampened vibrations inherent with helicopter operation will be transferred through the aviator's body. All these effects lead to human factors such as discomfort, fatigue, and in the long term, musculoskeletal disorders, and degenerative spinal disease.

Unfortunately, the nature of understanding deficiencies in pilot/cockpit interface develops over time and often comes through trial and error. Feedback from the user, in this case, the pilot, goes back to the engineers and schematics for cockpit design are adjusted within the requirements for future aircraft acquisition. With USMC helicopters service lives known to exceed 45 years as was the case with the CH-46 Sea Knight, pilots are often left to cope with the cockpit design as is. Finding solutions or modifying the cockpit can be difficult and something as simple as a supplemental seat cushion requires rarely achieved approval from U.S. Navy Naval Air Systems Command (NAVAIR). *Time Magazine* quoted a similar U.S. Army regulation that explains the reasoning behind the complications of an aftermarket seat cushion;

The crash-worthy seating system installed in today's helicopters was designed and tested as a system. Each component of that system has a specific purpose, whether it is for crash attenuation, dynamic overshoot prevention, providing the optimal buttocks reference point, properly interfacing with the restraint system or to provide you with optimum visibility. Modifying the seating system without thorough testing can cost you your life during an otherwise survivable crash.⁴

Protection from a catastrophic event over protection from long term bodily wear and tear has long been the stance of NAVAIR. The article then goes on to quote a U.S. Army aircraft mishap report where the helicopter pilot had modified his seat without approval;

This article is based on an OH-58D(R) Class A accident where the pilot placed an aftermarket seat cushion on top of the original aircraft seat to make it more comfortable to fly. The pilot was fatally injured during the crash. Changing either the buttocks reference point or the energy absorption ratio of the cushion

will lead to increased energy forces applied to the body during an accident. This can make an otherwise survivable accident deadly.⁵

The purely comfort-based decision made by this pilot is why modification of the cockpit in any way requires NAVAIR approval. In military helicopters, when it comes to ergonomic design considerations of the pilot seat, the balance of comfortability versus survivability is always going to sway toward the latter. The principle concern is the safety of the crew in a combat environment. The armored, crash attenuating or “stroking” seats protect the crew from enemy fire and increase the chances of surviving a crash or hard landing. The Department of Defense will not sacrifice survivability in their aircraft seats for good reason. As Dick Healing, a former U.S. Navy Safety Chief, stated in a 2011 *Stars and Stripes* article, “A significant issue is that the seats have been designed to sustain forces of a crash with little accommodation of normal flying comfort. Even though the crashes occur infrequently, about 90 percent of the design is focused on that rare event.”⁶

C. Medical Treatment

As far as medical treatments, the most common option for USMC pilots and aircrew is to seek medical assistance from their squadron flight surgeon. The first step will often consist of a thorough examination in which a baseline of pain will be established, and any neurological effects will be documented. If the pain or discomfort is new and without any neurological symptoms, the patient will have their symptoms treated with non-steroidal anti-inflammatory drugs (NSAIDs). This is commonly a small dosage or prescription for ibuprofen or naproxen.⁷ If the problem persists, or the pain becomes chronic, the flight surgeon will refer the Marine to a specialist, removing them from flight status in the interim. This is where x-rays will be taken

and the course of follow-on treatment will be prescribed.⁸ For Many USMC rotary wing aircrew, the next step is physical therapy and regular adjustments by a chiropractor but for some, a now identified serious medical condition, can lead to ending their career in aviation. The guidelines flight surgeons follow are set forth by the Naval Aerospace Medical Institution (NAMI);

If the pain is not alleviated within 10 days of treatment with NSAIDS, the aviator will require a waiver to remain on flight status. If the pain is caused by a more serious underlying condition, the requirements are more stringent. If it is determined that the aviator's symptoms are caused by a bulging disk, or other nerve impingement, they will be removed from flight status until they have been asymptomatic for six weeks. Even if they have surgery to remove the bulging disk material, they will not be returned to flight status until they have been asymptomatic for at least six weeks. The further requirement is that they maintain acceptable range of motion and be able to pass a USN or USMC fitness test. If the surgical treatment is more extensive, the grounding may last up to six months for cervical fusions or be permanent for multi-level discectomies.⁹

The "NAMI Whammy" as it is known in the military aviation community, is the termination of flight status by the Naval Aerospace Medical Institution.

D. Factors Inhibiting Treatment

Fear of being grounded or having their career come to an end is enough to keep most pilots and aircrew quiet when it comes to their injuries. Being deemed medically down, even if temporary, can mean falling behind peers in obtaining flight qualifications and designations,

losing currency and proficiency, or worse, missing a deployment cycle and being bumped to another squadron. Falling behind peers creates an anxiety of missing opportunities like being selected for career enhancing schools and being nominated for higher level instructor ratings. With all of this comes Military Occupational Specialty (MOS) credibility, and MOS credibility is a tremendously important factor for promotion and re-enlistment eligibility. These factors weigh heavily on the minds of aviators when deciding whether or not to consult their flight surgeon or to just “suck it up.” Being taken off flight status will also impact the pay of anyone involved in flight related duties. The loss of “flight pay” can reduce yearly earnings by thousands of dollars depending on the seniority of the Marine. Medical disqualification can also render Marines ineligible for certain aviation career retention bonuses.

When aircrew resist seeking out treatment for something that might only require one or two chiropractic adjustments a month, an acute spine injury can become chronic over time. One study done by the Human Performance Resource Center (HPRC) found that;

Both international and American studies have found that a significant and increasing number of helicopter and fighter pilots suffer from neck (and other) pain as a result of their occupation. Many pilots seek out civilian rather than military medical treatment to avoid being grounded or losing their flight status. Others self-medicate with high doses of over-the-counter remedies such as ibuprofen, which can cause other health problems when taken long term.¹⁰

Additionally, an article in *Stars and Stripes* detailed an anonymous survey in 2011 conducted by the Navy Safety Center that “Fully 85 percent of military aviators and crewmembers who responded to a Pentagon-funded survey earlier this year reported that they experience discomfort or pain while flying in helicopters.”¹¹ The article went on to detail that 60

percent of those polled in the survey claimed to avoid treatment for fear of losing their flight status.¹² In fact, the 2011 *Stars and Stripes* article quoted Kurt Garbow, then Director of Aviation and Operational Safety in the Office of the Deputy Assistant Secretary of the Navy as saying, “What we are finding out is that many pilots and aircrew have been going outside the military to obtain treatment because they are concerned about their ability to be medically qualified (to fly). They are afraid of losing their careers.”¹³ In 2010, Kadix Systems, a private consulting firm, was hired by the U.S. Navy to conduct a Business Case Analysis (BCA) for the improved Navy Helicopter Seat System. The BCA polled both Navy and USMC helicopter pilots and aircrew that were currently serving as well as those who were retired. There were 1,714 individuals within that subject group that responded. One of Kadix Systems key findings was that of the pilots and aircrew that were still serving, 59.23 percent admitted to avoiding medical attention over the fear of being taken off flight status.¹⁴ The culture of avoiding medical treatment that exists within this community is a significant contributor to the long term chronic injuries that exist within its veterans’.

II. Environmental Contributors

A. Overview

To get an understanding of back pain in helicopter pilots and aircrew, the environment and the factors at play must be evaluated. The center of the issue is the spinal health of the aircrewman and what exactly seems to negatively impact it the most. While there are many factors, three to consider are: posture, the wearing of flight equipment, and duration of exposure which can be associated with operational tempo.

B. Posture

The “Helo Hunch” is a common colloquialism within not just the USMC but the entire rotary wing community. It refers to the posture that helicopter pilots assume when they are operating their aircraft, as shown in Figure 1.

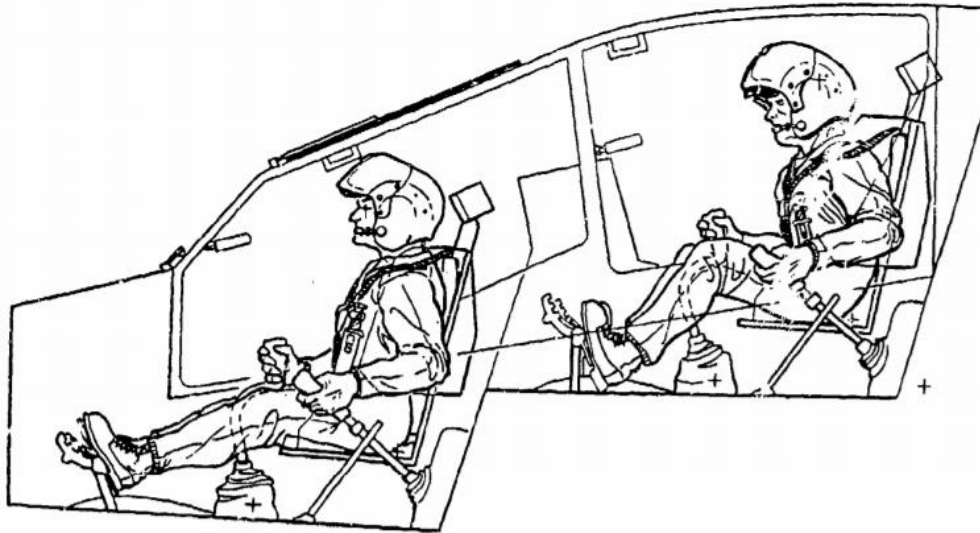


Figure 1. Helicopter aircrew posture. Hunched (right), upright (left).¹⁵

This hunched posture is caused by many factors. With the cyclic control centered between the pilot's legs, just aft of the knees, pilots will hunch over to ensure they are able to manipulate the cyclic forward through its full range of motion. Anthropometrically, in the seated position, the elbow is 3-5 inches above the thigh. Holding the cyclic over time is fatiguing and causes the pilot to hunch forward to rest their elbow on their thigh. The rigid design of most armored chairs in helicopter cockpits can be adjusted fore and aft, as well as up and down; they cannot however, recline. The built in back padding combined with the pilot's thick survival vest, pushes the pilot forward in their seated position creating a starting point that is often 90 degrees or less. This is compounded by the fact that, in order to fit securely in the seat, all of the survival gear on the vest is mounted on the pilot's chest and stomach. In combat situations, this would include an

armored plate that can weigh over 5 pounds. Fatigue over time will draw the pilot forward in their seat, resulting in the common helo hunch posture. Describing the effects of the helo hunch, Sargent and Bachmann stated that “In the low back, this posture converts the normal S-shaped spinal curvature of the spine to a more C-shape. This shortens the deep spinal muscles and stretches the superficial ones. This is an unstable posture and results in excessive fatigue. In addition, this posture forces the front edges of the vertebrae together, and pulls the posterior edges apart putting uneven pressure on the invertebrate disks.”¹⁶ The affected area of the spine will become inflamed and if not treated, continued exposure can change the shape of the vertebrae over time along with many other spinal injuries as seen in Figure 2.

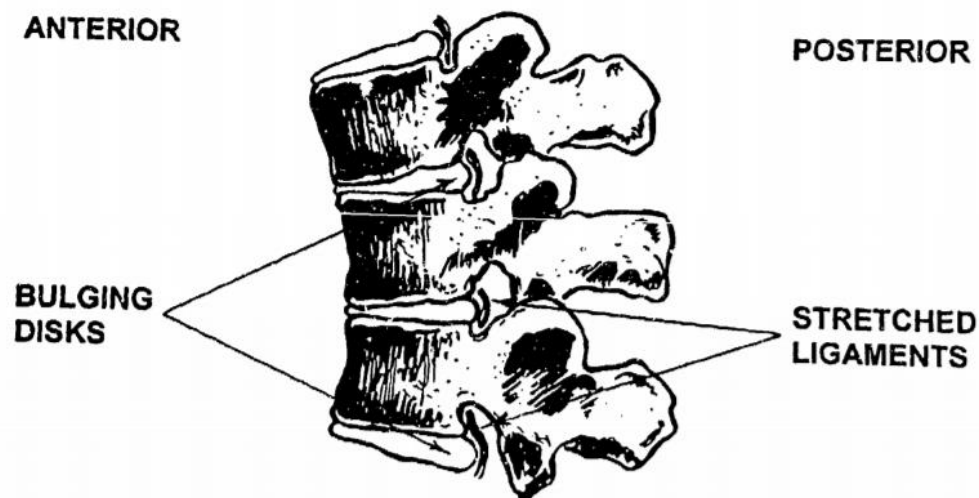


Figure 2. Bulging disks and stretched ligaments from hunched posture.¹⁷

While the helo hunch is most commonly associated with pilots, this does not imply that pilots are more likely to suffer from spinal injuries due to flight related duties. The small cabin dimensions of USMC helicopters along with the inflight duties of aircrew result in equally unsatisfactory posture. In fact, one report from the Naval Health Research Center stated, “However, when aircrew are compared with pilots, aircrew members had significantly more diagnosed back problems than pilots within both helicopter and fixed-wing aircraft groups. Adjusting for age,

helicopter aircrew members had more than three times the risk for back problems compared with helicopter pilots.”¹⁸

C. Flight Equipment

USMC pilot and aircrew flight equipment is issued and approved by NAVAIR. Every bit of flight equipment serves a specific purpose and is routinely inspected. The testing, evaluation, and fielding of new flight equipment is an ongoing process and like cockpit ergonomics, evolves through its use and the feedback from the user. The two biggest components to consider when it comes to military flight equipment is weight and restricted movement. Adding anything to the human body will increase weight and restrict movement. The science of kinesiology and biomechanics helps to determine just how much weight can be added and motion restricted, before too much efficiency is lost in performing a certain task. In this case, the task is flying and crewing a military helicopter. The balance between efficiency and flight equipment design considerations again, goes back to survivability. As technology advances and lighter, more durable materials are designed, weight and restriction can be reduced but not at the cost of survivability. Added weight throws off the body’s natural center of gravity and puts higher loads on muscles, tendons, ligaments, cartilage, and bones. The bulk of flight gear restricts the efficiencies of the body’s natural movement. For example, rotation about the torso is reduced by wearing a 30-pound flight vest. This places a higher than normal demand on neck rotation with a 10-pound helmet on the head.

Military pilots and aircrew wear helmets whereas headsets are worn in civilian aviation. Helmets can restrict vision in the peripherals, requiring an active scan by rotating the head about the neck and torso. Helmets also contain mounts for monocular Heads Up Displays (HUD),

Night Vision Goggles (NVGs), and battery packs. Counter weights are routinely added to the back of helmets to offset the weight of the NVGs' and HUDs' that are mounted on the front. NVG's restrict the field of vision to just 40 degrees requiring an even more active and aggressive head scan while flying at night. A pilot sitting in the hunched position, has now displaced their head forward and out of the stable and natural vertically aligned position with the spine. Muscles in the lower back must compensate by holding a position where the head, with additional weight, is forward of the natural sitting center of gravity. The head also needs to be rotated up (chin up) in order to raise the eye line back to a level position and above the instrument panel. This position places unnatural strain on the back of the neck.

The current vest issued to USMC helicopter pilots and aircrew is the Aircrew Endurance Survival Vest (AE), (Figure 3). Most if not all the equipment is attached to the front side of the vest which enables a secure fit in the seat. The official NAVAIR webpage describes the vests "The new AE system resolves deficiencies existing in legacy aircrew survival vests and fields upgraded armor protection. Two configurations of the new AE system are being deployed, one for mobile aircrew and another for those aircrew who remain seated during flight. The AE mobile aircrew vest weighs 29.6 pounds and the AE seated version 19.5 pounds — about 7 pounds lighter than legacy AIRSAVE survival vests."¹⁹ While improvements in weight are being made, there is still a substantial amount of weight acting on a Marines body. In combat, this weight will go up significantly. Pilots and aircrew will holster a 9mm service pistol along with ammunition on their vest. A sustainment pouch can be added that holds up to 5 pounds of additional survival gear depending on the type of operating environment. Aircrew will insert a ballistic plate in the front and back of the AE while pilots, who sit in an armored chair, will wear one on the front only. This can result in 20 additional pounds worn within the AE.



Figure 3. Aircrew Endurance Survival Vest. Pilot CMU-38/P (center), aircrew CMU-37/P (left & right)²⁰

D. Exposure

Exposure will be detailed in terms of time and frequency spent in the aircraft. It doesn't take critical analysis to infer that the relationship between spinal health in pilots and aircrew and exposure is likely one of direct variation. It can be reasonably deduced that the increased operational tempo from the wars in Iraq and Afghanistan have increased instances of neck and back pain within the rotary wing community over the last 15 years. One Army report on back pain in helicopter pilots and aircrew was quoted in a 2011 article "Rotary-wing operations in OIF (Operation Iraqi Freedom) and OEF (Operation Enduring Freedom) often require six to 12 continuous hours of prolonged sitting by the aircrew. With this increased exposure and resultant pain, aircrews are reporting decreased concentration and situational awareness."²¹ Additionally, according to one former U.S. Navy safety chief, "Ten years ago the average flight in a helicopter was 90 minutes. Today in Iraq and Afghanistan, it is not unusual to have six to eight hours (in the seat) so the amount of wear and tear on the body is significant."²² For reference, this

statement was made in 2011 which would make 10 years ago prior to OIF and OEF. While on deployment, it was not uncommon for USMC helicopter pilots and aircrew to fly on monthly hours waivers out of operational necessity. Normally limited to log no more than 100 hours of flight time in a calendar month, waivers granted by squadron flight surgeons bypassed this restriction to support critical combat missions.

During OIF and OEF, the increased operational tempo wasn't just felt while on deployment. The average deployment to dwell time, meaning ratio of time spent deployed versus time spent home for a USMC helicopter squadron was 1:2. For some Marine Light Attack Helicopter Squadrons the ratio was 1:1. This was detailed in one report in which General Joseph Dunford was quoted as saying "Under the budget caps imposed by the Budget Control Act of 2011, capacity will be reduced even further, and the dwell ratio for the Marine Corps could fall to 1:1"²³ This reduction in dwell time during OIF and OEF meant that time spent at home didn't necessarily equate to less time and frequency spent in the aircraft. New pilots and aircrew had to be trained on shorter timelines in order to be ready for deployments. Squadrons would return from deployment and quickly find themselves back in a pre-deployment workup cycle, once again ramping up flight hours. USMC helicopter pilots and aircrew paid a significant toll on their bodies during OIF and OEF and will continue to do so in an environment with such a high operational tempo, both at home and abroad.

III. Benefits of Chiropractic Treatment

A. Overview

There are many known and proven benefits for spinal health through regular chiropractic treatments. Chiropractors focus on treating and diagnosing mechanical and musculoskeletal disorders of the spine. Proponents of chiropractic treatment believe that any ailment of the spine which is directly tied into the nervous system, can also affect the general health and wellbeing of an individual. According to an article written by a Doctor of Chiropractic (DC), “Chiropractors focus on the intimate relationship between the nervous system and spine and hold true the following beliefs: biomechanical and structural derangement of the spine can affect the nervous system. For many conditions, chiropractic treatment can restore the structural integrity of the spine, reduce pressure on the sensitive neurological tissue, and consequently improve the health of the individual.”²⁴ For a chiropractor, the recommendation is almost always a non-drug treatment before calling for medication. This can be very beneficial for pilots and aircrew as it will deter the negative side effects of long term use of NSAID’s as described by Sargent and Bachmann. According to the American Chiropractic Association (ACA);

One of the most common and well known therapeutic procedures performed by doctors of chiropractic is spinal manipulation (sometimes referred to as a "chiropractic adjustment"). The purpose of spinal manipulation is to restore joint mobility by manually applying a controlled force into joints that have become hypomobile – or restricted in their movement – as a result of a tissue injury. Tissue injury can be caused by a single traumatic event, such as improper lifting of a heavy object, or through repetitive stresses, such as sitting in an awkward

position with poor spinal posture for an extended period of time. In either case, injured tissues undergo physical and chemical changes that can cause inflammation, pain, and diminished function for an individual. Manipulation, or adjustment of the affected joint and tissues, restores mobility, thereby alleviating pain and muscle tightness, allowing tissues to heal.²⁵

The description by the ACA aligns perfectly with neck and back injuries associated with USMC helicopter pilots and aircrew as a result of their flight related duties.

B. Rehabilitation

Another feature offered by Doctors of Chiropractic according to the ACA is that “Chiropractors have broad diagnostic skills and are also trained to recommend therapeutic and rehabilitative exercises, as well as to provide nutritional, dietary and lifestyle counseling.”²⁶ So simply exposing Marines to chiropractors, even without spinal manipulation, a visit can prove very beneficial. Navy Flight Surgeons Sargent and Bachmann agreed. One of their recommendations to help mitigate back problems in helicopter crews was a training program done at the squadrons for aircrew. This low cost solution could teach aircrew proper posture and ways to stretch and strengthen their core muscles.²⁷ There are currently no such programs that exist within USMC Helicopter squadrons. While squadron flight surgeons can recommend stretches and other exercises, it is on the individual Marine to build this into their routine. Currently, there are no dedicated spaces within squadrons for any sort of pre or post-flight rehabilitative exercises. Bringing about these changes will require a change in squadron culture and the approach to flight preparation and recovery.

IV. The Cost

A. The Annual Cost

In 2011, a defense consulting company, R Cubed, polled over 8000 military aviators about back pain associated with flight related duties. According to one *Stars and Stripes* article the survey found that as many as 80 to 90 percent of helicopter crew members suffered from back pain.²⁸ With 80 to 90 percent of this community reportedly suffering from back pain, there will be significant costs associated with short and long-term health care. This is especially true if Marines' backs continue to go untreated for all the reasons mentioned earlier. According to one study cited by WebMD, \$86 billion is spent annually on health care in America for neck and back pain with the average cost per person totaling \$6,096 compared to \$3,516 for people without neck or back pain.²⁹ This equates to a difference of \$2,580 in additional health care costs per year on average for individuals with neck and back pain. This figure does not account for lost wages, compensation for disability, or money spent training an individual to do a job they can no longer perform due to their disability and money spent to train their replacement. Of the approximate 10,000 active duty USMC rotary wing pilots and aircrew, splitting the difference in the survey done by R Cubed, it is likely that 85 percent suffer from neck or back pain. That could potentially put the costs for health care spent solely on neck and back related issues to nearly \$22 million a year. With a large percentage of Marines choosing not to seek medical attention during their active duty service, these costs will be seen post career through VA disability compensation payments and health care expenses accounting for a large portion of the billions spent every year. Millions more are lost every year when pilots and aircrew are medically retired. Not meeting service obligations can be viewed as a negative return on the

millions invested in aviation training per Marine. More will be spent on training replacement aircrew due to un-forecasted personnel shortages.

B. Training Costs

Kadix Systems, a private consulting firm, was commissioned by the U.S. Navy in 2010 to conduct a business case analysis (BCA) on the Navy Helicopter Seat System (HSS). The Navy, recognizing ergonomic shortfalls in the HSS, wanted to get an idea of what the back injuries as a result of the HSS were costing them each year. Kadix was able to establish baseline financial impacts for several different categories. Its research focused on medical expenses, expenses as a result of lost time, and training costs. Costs associated with both primary and secondary effects of the HSS on Navy and Marine Corps pilots alone totaled over \$10 million a year per pilot (Figure 4).³⁰

Annual Costs	Pilot
Medical	\$421,210
Lost Time	\$2,546,881
Disability	Not available through VA
Training	\$7,654,412
Mishap	Not available
Total Baseline Cost (pilots only)	\$10,622,503

Figure 4. Annual Cost for Pilots due to HSS Deficiencies³¹

Kadix Systems was unable to obtain exact costs related to disability payments for this subject group. One can reasonably deduce that a substantial portion of the \$63.7 billion spent on disability compensation by the VA every year, comes from the USMC rotary wing community. For the purposes of this thesis, a request to the VA via the Freedom of Information Act was

submitted for the exact dollar amount spend compensating veteran USMC helicopter pilots and aircrew as a result of spinal disability since 2001. The response from the VA was unable to provide an exact dollar amount.

C. Cost Benefits

Chiropractic care has been the subject of countless cost-benefit analyses done worldwide. In most cases, annual health care costs are compared between groups in which individuals with neck and back pain did not supplement their treatment with chiropractic care and those that did. Studies have shown that in the long term, annual health care is less in those who receive chiropractic care. The greatest savings come through fewer medications and surgeries. One journal article published in 2014, analyzed multiple cost benefit analyses stating;

Twenty-five publications were included (11 trial-based economic evaluations). The studies compared cost-effectiveness and/or cost-utility of manual therapy interventions to other treatment alternatives in reducing pain (spinal, shoulder, ankle). Manual therapy techniques (eg, osteopathic spinal manipulation, physiotherapy manipulation and mobilization techniques, and chiropractic manipulation with or without other treatments) were more cost-effective than usual general practitioner (GP) care alone or with exercise, spinal stabilization, GP advice, advice to remain active, or brief pain management for improving low back and shoulder pain/disability. Chiropractic manipulation was found to be less costly and more effective than alternative treatment compared with either physiotherapy or GP care in improving neck pain.³²

V. Discussion and Recommendation

A. Overview

With well documented studies stating both the health and financial benefits of chiropractic care, providing this service to USMC helicopter pilots and aircrew should be a priority. While Navy medicine does provide contracted chiropractors, resources are scarce and not offered at every duty station. Because this service is provided by contractors, chiropractic care is rarely available while deployed where Marines are flying the most hours. At home, with such a high operational tempo, Marines are often unwilling or unable to take the time required to get away from the squadron and over to the medical facility. This process can take hours with time spent in transit, wait times, and time for the treatment. This makes it very difficult to fly and train on days where such a large portion of the day is spent away from the squadron. Due to the daytime hours of the chiropractors, Marines on the night schedule are unable fly as a daytime appointment would violate their crew day which restricts them from entering any “official place of business” until much later in the day. Some command climates place a stigma on missing time from work which can deter Marines from making appointments. Operating in this time constrained environment of squadron life contributes to Marines not receiving routine, preventative, and restorative chiropractic care.

B. Mobile Healthcare

Easily accessible chiropractic care is the key to preventing the current and future population of active duty USMC helicopter pilots and aircrew from becoming veterans with exorbitant medical and disability costs. Mobile health units providing chiropractic care and

consultation is key in preventing acute neck and back pain in USMC pilots and aircrew from becoming chronic. A mobile care unit that travels directly to USMC squadrons will mitigate time constraints faced by squadron personnel. Having a mobile unit set up outside the doors of a squadron would enable Marines to receive treatment and consultation before or even after flying the same day. Guided, therapeutic exercises along with stretching and spinal manipulation after a 6-hour training flight would prevent inflammation and other symptoms associated with acute neck and back pain.

HABITS for Life experimented with mobile health units in New Mexico in an attempt to study how they can impact a local population, the healthcare system, and cost benefits. The study was done over the course of 3 years and at no cost to the local population. The theory was that the convenience of mobile health units would encourage the local populace to receive health screenings, identify conditions that were at risk of deterioration later in life if not treated, and educate the population on the importance of regular health assessments. One journal article pointed out that HABITS for Life found that “A key factor often overlooked, in decreasing the burden of disease on the healthcare system, is prevention or delay in developing age-related diseases through accessible and timely identification of health risk.”³³ The HABITS for life experiment concluded that mobile health units fulfilled the populations need for easily accessible health screenings and that people were more likely to seek screenings through convenience. Additionally, people as well as the health care system would have a significant long-term return on investing in mobile health units through the treating, delaying, or prevention of chronic illness from developing over time.³⁴

One journal article reviewed over 50 articles on the use of Mobile Health Clinics (MHC) within the U.S. healthcare system. The authors concluded that;

A growing body of literature supports that MHCs are a successful and cost-effective model of healthcare delivery uniquely positioned to assess and fulfill the needs of underserved populations nation-wide. Through the act of driving directly into communities and opening their doors on the steps of their target clients, mobile clinics have been shown to be able to engage and gain the trust of vulnerable populations. Because MHCs can overcome many healthcare barriers, services provided by the MHCs have been shown to improve individual health outcomes, advance population health, and reduce healthcare costs compared to traditional clinical settings.³⁵

Other benefits of a mobile system would be the reduction of patient volume at the clinics. This would streamline appointments for personnel that require the same care but are not subject to the same time constraints of an operational fleet squadron. In the long run, providing Marines with easily accessible preventative chiropractic care for neck and back injuries could help significantly reduce the population of veterans requiring costly health care and disability compensation each year.

C. Conclusion

Degenerative spinal health within the USMC rotary wing community as a result of its flight related duties is well documented. Improving ergonomics in military helicopter design has made significant strides since the first military application of the helicopter in the 1950s. Implementing improvements is slow due to the lengthy service lives of military aircraft.

Exposure to sub-optimal conditions as demonstrated by Kadix Systems' analysis of the HSS has been compounded by the high operational tempo over the last 17 years. New technology has enabled flight equipment materials to become lighter, stronger, and more streamlined. It is understood, however, that there is a stark difference between civil-aviation and military aviation when it comes to ergonomics. Ultimately, survivability and crash worthiness is the principle factor when innovating new technology and design.

Fear of the "NAMI Whammy" can only be overcome by changing the culture that currently exists when it comes to Marines taking care of their bodies. When chiropractic care is mobile and easily accessible it will become part of an aviator's everyday routine at the squadron level. This will change the lens through which this community and its culture view medical care. Routine, preventative care will no longer be associated with the negative stigma that plagues it today. Living with pain and crippling injuries later in life cannot be shrugged off as the cost of doing business in the rotary wing community. No longer should a veteran's body have to subsidize the cost of serving their nation with unnecessary wear and tear and at the expense of their own quality of life. Without having to sacrifice time to train for time to heal, mobile health care will encourage the rotary wing community to obtain treatment. The implementation of mobile health care is already utilized by Navy Medicine for dental check-ups, audiograms, and blood drives. Bringing this same concept to the application of chiropractic care is critical to preserving the force. Providing Marines with accessible preventative care that is proven to reduce long term health complications will save from the millions of dollars spent and lost every year as a result of neck and back injuries. While the subject group of this thesis was USMC helicopter pilots and aircrew, the same principles can be applied across the Department of

Defense. As the population of veterans who receive disability compensation continues to rise along with healthcare costs, it is imperative to implement measures that are proven to reduce spending and more importantly, increase quality of life. Truly ensuring Americas veterans are provided with the care and benefits they have earned through their service would be enabling them to retire with a pension rather than disability compensation.

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⁵ Ibid.

⁶ Seth Robson, "Survey: Copter Pilots Seek Civilian Medical Treatments in Attempt to Save Careers." *Stripes.com*, May 13, 2011, <https://www.stripes.com/news/survey-copter-pilots-seek-civilian-medical-treatments-in-attempt-to-save-careers-1.143459>

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⁹ Ibid, 4.

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¹² Ibid.

¹³ Seth Robson, "Survey: Copter Pilots Seek Civilian Medical Treatments in Attempt to Save Careers." *Stripes.com*, May 13, 2011, <https://www.stripes.com/news/survey-copter-pilots-seek-civilian-medical-treatments-in-attempt-to-save-careers-1.143459>

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