



Chronic Back and Neck Pain in Pilots Flying Different Aircraft

Authors

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Abstract

Many studies have been conducted in relation to the prevalence of chronic low back pain in aviators. Other studies have been conducted in relation to the prevalence of neck pain, with few researches combining the two. This research investigates the relationship between the prevalence of persistent neck and backache in aviators. The research constitutes an articles review, with relevant articles being selected based on their discussion of the topic. A search conducted using the key words resulted in 18 relevant articles. Most of the articles discuss the prevalence of low back pain in aviators, with others looking at neck pain in different types of aircraft pilots. The results of the article review indicate a higher incidence of the symptoms in aviators compared to the general population. Helicopters have a higher incidence, with the civilian pilots having a relatively lower prevalence compared to military pilots.

Introduction

Aviation is an area that is linked with globalization. People can travel to different parts of the world at speeds that were at one time unimaginable. Some of the other benefits that the industry has introduced include growth in international trade and international migration. Careers have also been developed because of this industry, with one of the most prestigious of these occupations being piloting. Man's desire to take to the skies became a reality in the 20th century. After realizing this dream, the ingenuity led to the development of different types of aircrafts. Speed has also been a factor in the aviation industry. As a result, aviators and engineers have constantly increased the speed and altitudes that flights can achieve.

However, the industry has experienced a number of problems, especially to pilots who fly the different

aircrafts. One problem that has been the subject of considerable discussion in different literature materials is the occupational hazards that the pilots in the various aircrafts faced. Different researchers have looked at health issues related to flying, including deafness, visual disturbances, and hypertension. Some of the researchers also looked at the effects of being a pilot on back and neck pain. Some factors that may cause back and neck pain in the aviation pilots include the vibration caused by the engines, the long hours required in some flights, and in some cases, the inadequate adjustment of seats for individual pilots.

The association between chronic neck and back pain and being an aviation pilot can be made by looking at the history of one of the aviators who presented with back pain. The patient has served in the air force for 37 years and retires at the age of 56 years.

In his aviation career, he flew a helicopter for the United States Navy and later worked as a civilian pilot for seven years at one of the local companies. He retired only after he started experiencing progressively increasing back pain. He currently uses a walking stick, and has had one of the hips replaced. He is also on analgesics, which he picks fortnightly at the local clinic. The symptoms developed when he was still working for the military. However, he concealed the situation to proceed with the benefits. He is an example of the many pilots with constant neck and back hurting. Consequently, there is a need to find any association between career and the symptoms. This paper uses the findings of various researchers to investigate persistent back and neck pain in pilots who fly different aircrafts.

Neck and back pain and their relation to flying

Chronic back and neck pain are common medical conditions in any health institution. Health researchers have mainly attributed them to the occupation of the patients. The association between back pain and aviation has widely been studied, with different researchers having different conclusions. The types of aircrafts and their relation to back pain were also studied, with some of the researchers such as Simon-Arndt, Yuan, and Hourani concluding that there was no clear association between the two⁽¹⁶⁾. Other researchers such as From, Barzilay, Caine, Margaliot, Forecast, and Gross concluded that the risk of back pain was increased in aviators, although it was not associated with the flight types⁽⁹⁾. Despite these extensive studies on back pain and aviation, few researchers have studied neck pain and its relation to flying. As a result, there is hardly any study combining the problem of back pain and neck pain and their relation to being a flight pilot.

Grossman, Nakdimon, Chapnik, and Levy are some of the researchers who conducted a study on the effects of different flights on their pilots⁽¹⁰⁾. The researchers attributed neck and back pain to two major factors in flight pilots, namely whole body Vibration (WBV) and acceleration forces⁽¹⁰⁾. These

factors, according to the researchers, acted in concert with the head loading on the muscles of the neck to cause the chronic tenderness that the pilots experienced⁽¹⁰⁾. Neck hurting was associated with acceleration, NVG, the helmets, and inadequate rest between flights in some of the aviation areas⁽¹⁰⁾. On the other hand, backache was a combination of these factors in addition to the poor positioning in the cockpit seats for the pilots.

The posturing of the pilots in-flight is a major factor in the development of back pain. According to De Oliveira and Nadal, posture can be a target in the reduction of cases of persistent back and neck hurting⁽⁶⁾. Common helicopter vibrations were also confirmed to be the main factor in the causation of lower back pain⁽⁶⁾. Fighter jets have little predisposition to vibrations that are common to helicopters. The pilots were reported to have experienced unending neck and back pain. Therefore, there is a different reason for these types of aircrafts. Some of the researchers such as De Loose, Van Den Oord, Burnotte, Van Tiggelen, Stevens, Cagnie, Witvrouw, and Danneels reported that the pilots flying the F-16 fighter planes were predisposed to these symptoms based on the sudden movements that the planes were capable of making⁽⁵⁾. Fighter pilots also have a rather physically demanding work. They constantly have to flex their neck as they operate the multi-million dollar machines⁽⁵⁾. This situation may be a direct contributor of the unremitting neck ache that they are reported to experience.

In addition to the posture that the aviators have to take while flying their aircrafts, the headgear that they wear was also reported being an addition to the weight on their heads. The standard issue of most helicopter pilot helmets includes night vision apparatus, which demands the pilot to constantly flex his or her head while looking at the instrument panel as Salmon, Harrison, and Neary confirm⁽¹⁵⁾. This finding may reveal the high incidence of neck ache in the aviators. In relation to the causation of low back tenderness in pilots, another suggested cause is the damage that is done to the lumbar spine

in the flights by the vibration from the helicopters⁽⁹⁾.

Although Froom et al. state that there is little association between vibration in the aircrafts and their association with backache, they confirm that the cause may be related to the long flight hours that demand the pilot to remain seated for long periods⁽⁹⁾. However, vibration in the helicopters is supported by most of the other studies that included these types of aircrafts⁽⁶⁾. In most of the studies discussed above, the researchers managed to conclude that the persistent neck and back pain was not caused by a single factor but a combination of many factors. However, the researchers concentrated on the factors that their individual studies hypothesized to be the most important in the causation of unceasing neck and backache.

Materials and Methods

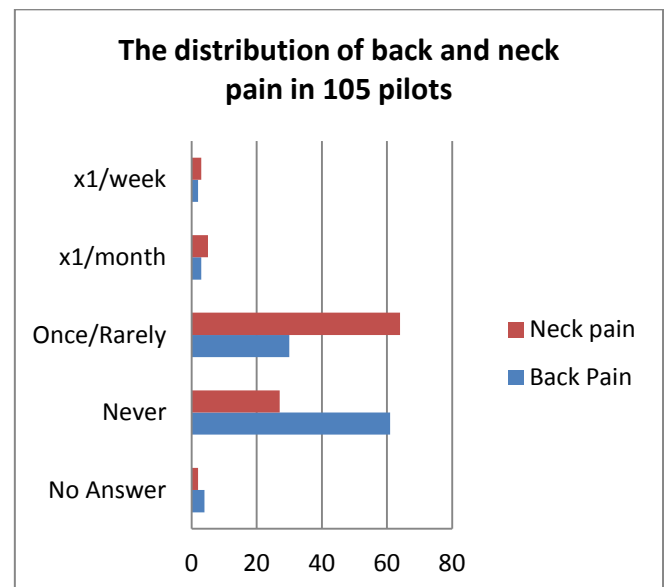
Procedure

The selected materials and the strength of a research in an article enable the making of strong conclusions and evaluation of any knowledge gaps. In this research, an article review provided the best way of answering the study objectives, as this method has the advantage of saving resources and time while it also provides strong conclusions that are backed by the findings of the researchers. After setting the research objectives including investigating the relationship between the different flights and their relation to back and neck pain, the next step in the research was to investigate the best method of achieving these objectives.

The appropriate databases where credible research articles on the subject were available were established. The findings of these articles were evaluated to guarantee adequate conclusions. Qualitative methods of analysis were used, with the results obtained being used to make appropriate conclusions. The guiding principles during the analysis of the research were the objectives formulated for the study.

Methodology of the Various Studies

Most of the research papers that were eventually used to assess the relationship between flight pilots and chronic back and neck pain used qualitative methods to investigate their respective hypotheses. In one of the researches from the results, Wagstaff, Jahr, and Rodskier were investigating spinal symptoms in fighter pilots that were induced by the acceleration forced (+G_z)⁽¹⁹⁾. These researchers used a questionnaire survey to answer the questions devised by the group⁽¹⁹⁾. The fighter pilots in different air bases later filled the questionnaires. The analyzed data was to be used to assess how often they reported having back pain and neck pain after a considerable period of flying⁽¹⁹⁾. The more prevalent of the two conditions among the 105 pilots was neck pain⁽¹⁹⁾. The figure below shows this distribution.



In another study, the researchers investigated the in-flight effects of vibration, posturing, and fatigue on the back muscles in 12 Brazilian civilian pilots⁽⁶⁾. The participants were monitored during their helicopter flights, which were lasting an average of 2 hours⁽⁶⁾. They recorded the contractility of the muscles before the pilots took to flight and used surface electromyogram (EMG) as the main test in the study. They also measured the vibration of the pilot sets in-flight using the triaxial accelerator and used the median frequencies (MF) in the power spectra of EMG to measure fatigue⁽⁶⁾. The muscular

activity in the aviators is one of the most important associations made between the development of persistent neck and back tenderness. These studies indicate that the causation of the neck and back pain have a more physiological and anatomic relationship.

Another study also investigated back symptoms and flying different aircrafts. The study by Grossman, Nakdimon, Chapnik, and Levy provided a good basis for the current research⁽¹⁰⁾. In this research, the use of questionnaires was utilized. Different pilots operating different types of aircrafts answered these questionnaires. The main types of aircraft pilots who completed the questionnaires included fighter aircrafts, attack helicopters, cargo planes, heliconpters, and utility flights⁽¹⁰⁾. The researchers also collected the demographic variables of the pilots, their type of flight, and the pain symptoms that they were experiencing. The weekly flights and the frequency of flying were also analyzed in the questionnaires⁽¹⁰⁾.

De Loose, Van Den Oord, Burnotte, Van Tiggelen, Stevens, Cagnie, Danneels, and Witvrouw also conducted a study investigating the effects of flying and chronic neck pain in pilots⁽⁴⁾. In this research, 90 volunteer F-16 pilots were each required to fill a questionnaire. Some of the participants had reported experiencing bilateral neck pain, and these were established to be 17 of the 60 participants⁽⁴⁾. The questionnaire contained the vital information on these pilots, the duration of the pain symptoms, training and flying hours⁽⁴⁾. Some of the measures that were taken in this study included the isometric neck flexion and extension strength, the lateral flexion strength, and the neck position sense⁽⁴⁾. The other measures included the cervical range of motion in these pilots in relation to the aviation hours⁽⁴⁾.

Orsello, Phillips, and Rice also conducted studies on the association between low back pain and in-flight height in military helicopter pilots⁽¹⁴⁾. The survey was conducted among 1028 helicopter pilots drawn from the US Navy. The pilots were asked to open up concerning the low back pain and its relation to their work⁽¹⁴⁾. The total number of pilots that were

used for the final study was 544 after exclusion of the participants without the necessary data. The researchers performed a case control analysis, with logistic regression being done on height, the BMI, and the low back pain⁽¹⁴⁾. They also used Chi-square and Analysis of Variance (ANOVA) to synthesize the results⁽¹⁴⁾. These methods of analysis were appropriate to provide researchers with quality data on the topic.

In another study, the researchers investigated the various factors in the neck pain reported by the F-16 pilots⁽⁵⁾. In this study, the researchers sought to establish the relationship between neck pain and the F-16 fighter pilots in 90 male pilots⁽⁵⁾. The pilots were from the Royal Netherlands Air Force and the Belgian Air force. They were required to fill a questionnaire that was voluntary and anonymous⁽⁵⁾. The study followed the frequent episodes of neck pain that were being experienced in the air force. The researchers saw this situation as an opportunity to find the relationship between this kind of flight and the symptom.

Another selected study was that conducted by Hansen and Wagstaff investigating the prevalence of low back pain among helicopter aircrew in Norway⁽¹¹⁾. The researchers initially requested helicopter aircrew members in the country's air force (RNoAF) to participate in research that they were conducting⁽¹¹⁾. 204 participants responded consisting of a control group that was made up of pilots from marine and transport aircrafts in the country⁽¹¹⁾. The survey consisted of questions that assessed the prevalence of back pain in the pilots and the medical attention that they had sought over a period of two years⁽¹¹⁾. They were also required to answer questions regarding the leaves at the workplace that were necessitated by the low back pain⁽¹¹⁾. Low back pain along with other pain symptoms is considered important factors at the workplace for aviators. The reduction in the working hours can be attributed to the problem in some of the pilots.

In another selected research, the researchers used questionnaires to investigate the prevalence of low back pain in pilots⁽⁹⁾. The participating pilots in this

particular study were pilots from fighter planes, helicopters, and transport planes⁽⁹⁾. The pilots were supposed to report any symptoms of low back pain in the history of their flying careers together with how they had been affected. Sovelius, Oksa, Rintala, and Sittonen were among the researchers whose research was considered in this study⁽¹⁷⁾. In their research, they investigated the effects of acceleration forces on the muscle loading in pilots flying fighter planes⁽¹⁷⁾. The study utilized test subjects that were subjected to different forces and neck and back muscle loading in these participants examined⁽¹⁷⁾. The researchers measured the EMG activity of the various muscles in the back and neck in the 11 participating fighter pilots from Finland⁽¹⁷⁾. Salmon, Harrison, and Neary who looked at neck pain in military helicopter pilots⁽¹⁵⁾ conducted a study with a similar methodology as the current study. The researchers examined literature on unending back pain in military helicopters⁽¹⁵⁾. Ang, Linder, and Harms-Ringdahi also evaluated the relationship between being a military pilot and the prevalence of neck pain⁽²⁾. Their study primarily sought to establish the relationship between neck strength and fatigue in the helicopter and fighter plane pilots⁽²⁾. The pilots who were investigated consisted of 31 pilots with episodes of neck pain⁽²⁾. The group was also compared with controls that had no neck symptoms. In most of the studies, the control group was a group of selected civilian pilots. The assumption was that the pilots were less affected by the symptoms.

In another related study by Van Den, De Loose, Sluiter, Frings-Dresen, the researchers used participants with neck pain and those that reported no neck pain in their piloting career⁽¹⁸⁾. The researchers measured various determinants of neck pain in the participants, including the cervical range of motion, isometric neck muscle strength, and the neck position sense⁽¹⁸⁾. The researchers used analysis of variance (ANOVA) just like in other related studies to establish the relationship between the pilot career and the prevalence of neck pain⁽¹⁸⁾. Nevin and Means were among the researchers whose works were considered for evaluation. These

researchers evaluated the prevalence of pain and discomfort caused by wearing body armor for helicopter aviators⁽¹³⁾. The 68 helicopter aviators were required to participate in pain rating that was self-reported, and they used questionnaire that also included the times of flight⁽¹³⁾.

In a different study on the prevalence of low back pain in pilots flying rotary wings planes, researchers used participants from the Royal Air Force to fill a questionnaire⁽³⁾. Cunningham, Docherty, and Tyler distributed the questionnaires to air force pilots and other pilots flying civilian planes and the coastguard planes in the United Kingdom⁽³⁾. The questionnaires were similar to those used in the other studies since they consisted of the demographic information of the pilots, the prevalence of low back pain, and the duration of flying in these planes. A similar study by Drew using questionnaires was utilized for this current research. The questionnaires were distributed between two types of pilots: those flying high performance aircrafts and those that flew low performance aircrafts⁽⁷⁾. The questionnaire was also anonymous just like in the other studies, as it sought to establish the relationship between flight performance and the prevalence of spinal symptoms⁽⁷⁾.

In a similar survey that utilized the above methodology, Drew investigated the relationship between the sitting angle in airplane pilots, their G-exposure, and the spinal symptoms prevalence⁽⁸⁾. This study was also resourceful to the current study. The methodology was consistent with the conclusions. The results of the literature search also resulted in one useful thesis for research by Andrea Philips from the Naval Postgraduate School in California⁽¹⁾. The thesis was on back pain in helicopter pilots. The researcher also conducted a survey similar to the ones above⁽¹⁾. He sent the survey questionnaires to the participating pilots via email. These questionnaires were later sent back to him⁽¹⁾. In the last study by Kasin, Mansfield, and Wagstaff whose findings were utilized, the researchers assessed the risk of low back pain in helicopter aviators mainly considering whole body vibration (WBV)⁽¹²⁾. In this research, Kasin, Mansfield, and Wagstaff tested six helicopters in

operational relevant maneuvers⁽¹²⁾. Vibration magnitude was later calculated for each of the helicopters⁽¹²⁾.

Summary of the Methodology

Most of the articles discussed used surveys to investigate the relationship between the back and neck symptoms and the types of aircrafts that were being considered. Most of them had questionnaires that were handed to the participating respondents. The questionnaires were later analyzed to evaluate the existing relationships. In some of the articles, the researchers opted to measure the contributing factors to back pain. The factors included the whole body vibration, cervical range of motion, isometric neck muscle strength, and the neck position sense. Other researchers also measured the electrical activity from the muscles before, during, and after the flights. The methodology considered constituted various types of aircrafts and pilots. Most of the research studies used relevant methodology, which was adequate to make the conclusions that the researchers subsequently provided. They were also appropriate for consideration in this particular study and hence relevant in the making of conclusions.

Results

Most of the studies whose methods are discussed above, which were considered in the current study, concluded that there was a positive relationship between being a pilot and the prevalence of chronic neck and back pain. However, most of the researchers conducted a study that sought to relate the prevalence of either back pain or neck pain on the different types of planes. The results of these studies will be discussed next.

Chronic Neck Pain

One of the studies that investigated the effects of being a pilot and the prevalence of neck pain concluded that there were “no significant differences between pilots and aircrew with neck pain and their colleagues without pain, nor was there any effect of occupation” (18, p. 50). This means that the researchers did not find a significant

relationship between being a pilot and experiencing neck pain. On the other hand, Ang, Linder, and Harms-Ringdahl established that fighter pilots were predisposed to neck pain because of the increased loading and decreased muscle strength⁽²⁾.

De Loose et al. suggested that the neck pain experienced in fighter plane pilots was a result of the high loading that was experienced during the flights and that the problem was consistent in the pilots⁽⁵⁾. Some of the researchers even suggested the introduction of training programs that are specifically aimed at reducing the prevalence of neck pain in the military pilots⁽¹⁵⁾. Chronic neck ache was discussed in the research articles as being a big problem among pilots. In another study, flying a high performance plane was considered one of the main reasons why pilots experience persistent neck pain⁽⁸⁾. However, most of the studies mainly looked at the effects of being a pilot in the different types of planes and the prevalence of low back pain.

Chronic Back Pain

One example of a study that concluded that there is a relationship between chronic back pain and being a helicopter pilot is that of Kåsin, Mansfield, and Agstaff⁽¹²⁾. The researchers associated the pain with the whole body vibration that was the subject of their study. Other studies strongly linked back and neck pain to being an aviation pilot. Philips asserts, “The cause of most pilots’ back and neck pain is due to flying rather than other activities” (1, p. 25). This finding follows after the results of the survey showed that a few of the problems that the pilots had were attributable to other activities apart from flying.

The other researchers who found an association between flying and low back pain included Cunningham, Docherty, and Tyler⁽³⁾, Nevin and Means⁽¹³⁾, Sovelius and colleagues⁽¹¹⁾, Grossman, Nakdimon, Chapnik, and Levy⁽¹⁰⁾, and Hansen and Wagstaff⁽¹¹⁾. Despite these findings, there were still researchers who concluded that the prevalence of back pain in the pilots was not different from that experienced by other people in other careers that were not actively involved in flying⁽⁹⁾. Based on

their study, Froom et al. concluded that there was no relationship between vibration stresses in helicopters, the long-term damage of the lumbar spine, and subsequent unceasing low backache⁽⁹⁾. Most of these studies investigated different types of planes and their relation to either neck or back pain, or both types of pain. It is important to look at the different findings that the individual types of aircrafts provided.

Fighter Jet Aircrafts

Ang, Linder, and Harms-Ringdahl were some of the researchers who investigated the effects of chronic back pain related to the different types of aircrafts⁽²⁾. They concluded that fighter jet aircrafts and military helicopter pilots are at an increased risk of developing chronic low back pain⁽²⁾. This finding was related to the acceleration forces that were experienced at the different aircrafts. Some of the factors attributable to the development of unremitting neck ache in fighter jet plane pilots include the night vision gadgets that they wear, helmets, helmet-mounted displays, and the suits⁽¹⁾. These are responsible for the added weight that causes axial loading and the resultant chronic back pain.

Froom et al. placed the prevalence of chronic backache in fighter pilots higher than the prevalence of the same parameter in helicopter pilots⁽⁹⁾. In another study on the prevalence of neck pain in the F-16 pilots, the researchers concluded that the pilots are at a higher risk of chronic neck pain associated with the high performance of these planes⁽⁴⁾. De Loose and colleagues confirmed this observation in their own study on the F-16 pilots⁽⁵⁾. Some of the main reasons for the high prevalence of chronic back and neck pain in fighter pilots include the high G_z forces and the increased stress from long hours of flight⁽¹⁷⁾. The notion of fighter pilots being more at risk of chronic back and neck pain than other pilots was further supported by Drew Wed⁽⁸⁾. The researcher states that high performance in the different types of aircrafts was a problem that led to chronic neck and back pain⁽⁸⁾.

Fighter jets are associated with high velocities, large acceleration forces, and unique instrumentation in the cockpit. These factors are some of the major causes of back pain in the aviators who use them. In most of the research studies listed above, the aviators found an association between back pain and being a pilot in one of these aircrafts. The percentages of low back pain that was attributable to being a pilot in the fighter aircrafts varies from one study to the next. Apart from low back pain whose cause by jet aircrafts was ranked the second to helicopters, neck pain was established as being significantly caused by the jet planes⁽¹⁷⁾. Neck pain is prevalent in the jet pilots because of the additional headgear that they wear in comparison with other pilots flying other types of planes. The components include night vision goggles, the helmet, and other technological apparatus.

Helicopters

Military helicopter pilots were established as one of the groups at risk of developing low back pain because of long flying hours⁽¹⁴⁾. The designs of the helicopters were also established to be the main factors in the causation of low back pain in the pilots of navy helicopters. This aspect was also established to be the main factors that can be used to mitigate the effects⁽¹⁴⁾. In another study that is described above, the researchers found little significance between being a helicopter pilot and the likelihood of experiencing chronic back pain⁽¹⁸⁾. However, this was not supported by other findings from other research studies.

One of the other studies reporting an increased prevalence of back and neck pain in helicopter pilots was that conducted by Ang and colleagues⁽²⁾. They established that the prevalence of low back pain is related to the type of flight that one operates and the duration of the flight. Hansen and Wagstafe established that an increased prevalence of low back pain was mainly associated with flying helicopters for more than 2000 hours⁽¹¹⁾. Grossman, Nakdimon, Chapnik, and Levy were some of the researchers who investigated the effects of various aircrafts on spinal symptoms such as persistent neck and/or

back tenderness⁽¹⁰⁾. They concluded that the prevalence of these symptoms was more in helicopter pilots.

De Oliveira and Nadal further investigated the main reasons why the helicopter pilots are affected more than the other pilots did⁽⁶⁾. The previous hypothesis that claimed the symptoms occur due to fatigue, posturing, and vibration is not supported in their study. They concluded, "Other mechanical processes related to the constant helicopter vibration such as cyclic compression of disks might reveal the etiology of such pain and should be further investigated" (6, p. 322). Helicopter pilots were also confirmed as being associated with low back pain in another study by Froom et al.⁽⁹⁾. However, pilots flying the transport planes were more at risk of having chronic back pain in the study.

In another research finding, the researchers suggested that the prevalence of chronic neck and back pain in helicopter pilots might be reduced through active exercise therapy⁽¹⁴⁾. The researchers concluded that the pilots flying the helicopters are at an increased risk of developing chronic neck and back pain because of the increased hours of flight. Nevin and Means went further to evaluate the causes of chronic pain in helicopter aviators⁽¹³⁾. The findings were that the body armor that the pilots used was a positive contributor to chronic back and neck pain.

Andrea Philips also found that many pilots in the navy had at one time reported persistent back and neck pain⁽¹⁾. This group comprised mainly the helicopter pilots who worked for the navy. Kasin, Mansfield, and Wagstafe also reported increased prevalence of low back pain in helicopter pilots⁽¹²⁾. In most of the studies described above, the pilots that were most susceptible to chronic back and neck pain were the helicopter pilots and researchers in each of the studies suggested further studies to investigate the main forces behind the relatively high incidence of these symptoms in helicopter pilots. Some of the most common associations to back pain for the helicopter pilots are the vibrations and the long flight hours for the pilots^(6,14, and18).

Civilian Aircrafts

Civilian aircraft pilots were also at increased risk of developing low back pain and chronic neck pain. However, this situation was significantly less common in the military aircraft pilots. These pilots were used as the control group in some of the studies that investigated the prevalence of low back pain in pilots⁽¹²⁾. The studies on civilian aircrafts also found significant evidence where the pilots had experienced chronic back and neck pain⁽³⁾. The aviators reported that they had more of chronic low back pain as compared to neck pain.

Few of these studies found significantly large associations between back pain and being a civilian pilot. One of the reasons for this case include the fact that the researchers had based their hypothesis on the military air transport and that the field was more demanding than working as a civilian pilot⁽¹²⁾. However, there is a need to carry out more research on the implications that being a pilot in civilian commercial airlines has in the manifestation and development of spinal symptoms, especially chronic back and neck pain. Important to note is that the industry is more regulated with the pilots having lesser flying hours and with the assistance.

Discussion

In most of the research articles that were analyzed, there was a strong association between chronic back and neck pain and the piloting occupation. Helicopter pilots have been confirmed as the most commonly affected of all the pilots of the different types of aircraft pilots^(14,18,2, and12). Helicopter pilots are more predisposed to chronic back and neck pain because of the various factors in the propulsion systems of this type of flights. Localized muscle fatigue was determined in the studies as a major factor in the helicopter pilots. This observation was estimated through the measurement of the electric activity of the muscles⁽⁶⁾.

One of the few studies combining the effects of many factors on the prevalence of chronic back and neck pain in pilots was by De Loose et al. Some of the factors that act as a group in the causation of neck pain and chronic back pain in the pilots

included the isometric neck flexion and extension, the positional sense of the pilots, the range of motion, and the aircraft factors⁽⁴⁾. However, the aircraft factors were established as the main factors in the development of chronic back and neck pain.

In aircrafts with strong acceleration forces, the piloting of aircrafts without the appropriate support for the lumbar spine is one of the factors that lead to the development of lumbar pain after long periods of service⁽¹⁷⁾. There exist individual differences in the causation and prevalence of this pain. Therefore, the control may have to take an individual approach⁽¹⁷⁾. Pilots need to support their lumbar spine in the operation of the high acceleration aircrafts, as this strategy may be beneficial in the prevention of chronic back pain. In this case, the reduction in back pain depended on the level of support for the individual pilots.

One of the individual pilot characteristic that was described in the studies is the height of the pilot. Orsello, Phillips, and Rice stated that an increase in height had a resultant increase in the probability of experiencing low back pain for the fighter plane pilots⁽¹⁴⁾. In their study, they observed, "For every 1" increase among male pilot height values, the odds of experiencing significant LBP in-flight increased by 9.3%, with those equal/taller than median (71 in.) having over twice the odds compared with those shorter" (14, p. 32). The graph below shows the relationship between the height of the pilots and the odds of developing chronic back pain.

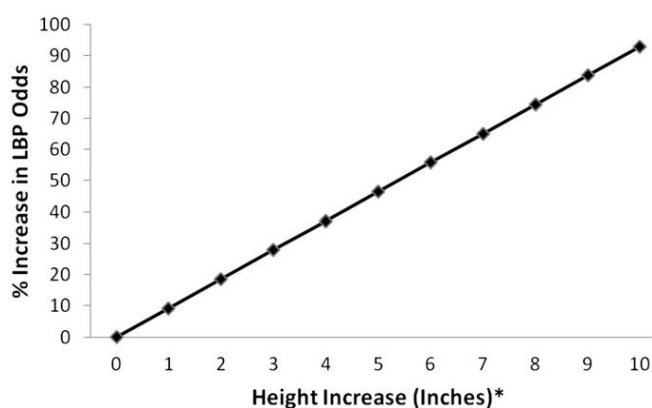


Figure 2; Low Back Pain per unit (inch) increase in height values among male pilots Source: (Orsello, Phillips, & Rice 2013)

The physical characteristics of the pilots were also the subject of other studies that try to relate them to the prevalence of chronic neck or back pain. The duration of flying varied among the individual pilots and the consistent findings are that the pilots that had flown for longer in any type of aircraft were more affected in relation to those with fewer flight hours. The increased flying times for the participating pilots had a bearing on the stresses that their muscles went through. The increase in flying time is associated with increased prevalence of chronic low back pain⁽¹⁹⁾. The results also apply for persistent neck pain⁽²⁾. Most of the pilots who were surveyed in the researches were silent about their back pain with the reason that they might have consequences in their careers⁽¹⁹⁾. In most cases, the researchers had to use retrospective methods of enquiring about the chronic back and neck pain in these pilots in order to make them more open about the symptoms.

The prevalence of pain varies in the different types of aircrafts as stated above, with the helicopter pilots being described as the most predisposed in most studies. The prevalence of chronic neck pain is more common in fighter pilots while the one in low back pain is more in helicopter pilots⁽¹⁰⁾. Apart from the location of the persistent pain, the prevalence of pain is also determined by the type of aircraft, the time of service, and the individual characteristics as stated above. Some of the researchers who conducted extensive work on the variations of the pain among the different types of aircraft pilots include Grossman, Nakdimon, Chapnik, and Levy⁽¹⁰⁾. In their research, they further supported the distribution of these symptoms in the pilots. The figures below represent some of their findings.

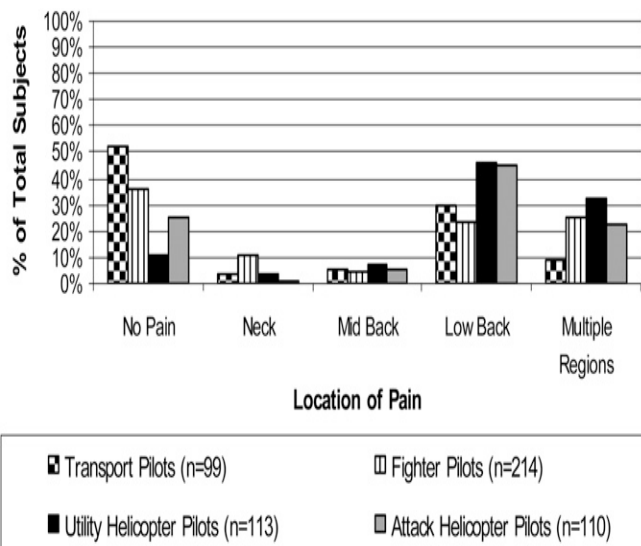


Figure 3: Regional distribution of pain in aviators
Source: Rossman, Akdimon, Hapnik, & Levy, 2012

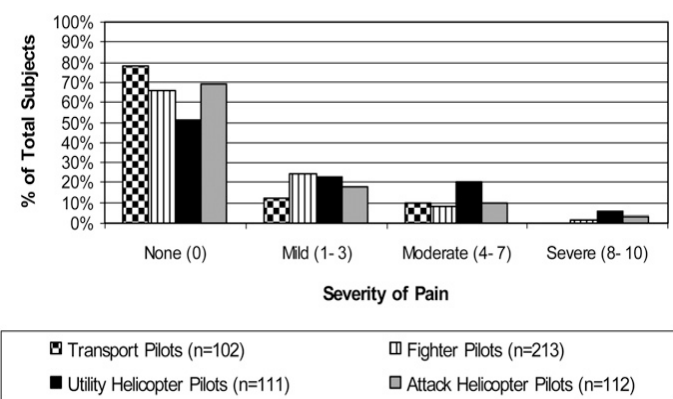


Figure 4; Aircraft variation in pain severity
Source: Rossman, Akdimon, Hapnik, & Levy, 2012

Despite the above findings incriminating the types of aircraft in the causation of chronic neck and back pain, the individual pilots were considered important in the causation of their own neck and back symptoms. Pilots take different positions when flying their aircrafts while sitting in positions that predispose them to pain⁽¹⁸⁾. The posturing of the cervical spine and the back may be corrected through adequate training for these pilots and provision of seats that are specifically designed for each of the pilot⁽¹⁸⁾. The companions of pilots and fellow aviators and the position in which they are seated in a plane also affect that manifestation of the described symptoms. The prevalence of chronic neck and back pain is also dependent on the total flight hours for these pilots.

The other individual characteristic that was subject to investigation in some of the studies is the muscle strength for the various supporting structures⁽²⁾. For people with strong supports for the neck, the incidence of neck pain was considerably low as compared with those with reduced muscle bulk⁽²⁾. The factors that were responsible for the development of chronic neck pain in those pilots with less muscle bulk include the rapid changes in velocity for the different types of aircrafts, and the ability of bulk muscled individuals, to adequately support their necks. Therefore, the study indicated that bulky muscled individuals are less predisposed to getting constant low back and neck pain and neck tenderness in contrast to the natural predisposition that bigger people have to low back pain.

In most of the contemporary aircrafts, aviators are required to wear special armor and clothing for their protection and to make them efficient pilots. This inference is mainly an observation in the military aircrafts, especially the fighter and military helicopter pilots. There has been growing concern that the apparatus that the pilots are required to wear may be contributing to their cockpit weight and the overall stress in their neck and back, thus multiplying the acceleration forces. Nevin and Means investigated the relationship that the added body armor for the pilots had in the predisposition of chronic pain⁽¹³⁾. They found out that although the initial intention was to make the armor lighter for the pilots, the added weight had a bearing on the muscles in the pilots⁽¹³⁾. They reported increased stresses to the lower back muscles and thus the development of chronic back pain in the pilots⁽¹³⁾. The prevalence of pain in most of the research findings pointed to more pain for the air force pilots. Civilian pilots were less affected because, as most of the researchers stated, these pilots operated in a tightly controlled field with professionalism being highly emphasized⁽⁵⁾. The exception was a study carried by Cunningham, Docherty, and Tyler whose findings pointed to a higher prevalence of persistent pain in the civilian pilots compared to the air force pilots contacted in the study⁽³⁾. The findings are illustrated in the following figure.

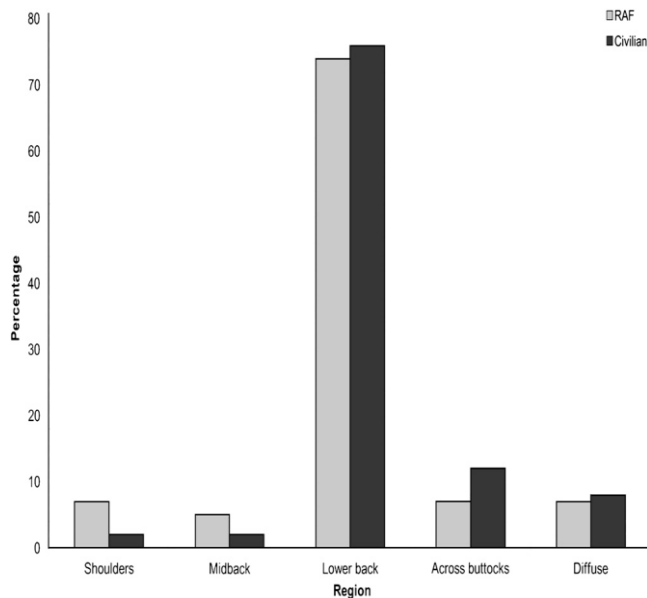


Figure 5; location of pain in different pilots Source: (Cunningham, Docherty, Tyler, 2010)

The findings above can be described as being different from the other studies because only one type of aircraft was used. The researchers obtained their data from the pilots of rotary wing aircrafts that are more in civilian as opposed to military transport use⁽³⁾.

The other significant factor in the prevalence of chronic pain, especially back pain, is that most of the pilots experienced it while in flight⁽¹¹⁾. The pain usually lasted a few hours after the flight and later subsidize after a certain period. The presence of chronic pain is a bother to the pilots and the aviation agency because it affects their quality of work⁽¹¹⁾. The number of leaves that the pilots ask can be reduced if the problem is tamed and/or more measures are taken to avoid its development⁽¹¹⁾. The prevalence of this pain is related to the number of hours that the pilots are flying that Hansen and Wagstaff described it as being different from the civilian chronic low back pain⁽¹¹⁾.

The prevalence of chronic neck and back pain in this study was established as a product of the individual characteristics and the airplane characteristics. In most of the researches, aviators who experience these symptoms because of being pilots have been involved in long periods of flight, poor positioning, or had taken a poor angle in the plane⁽¹²⁾. However, the study establishes that the

prevalence of chronic neck and backache in pilots is more than the prevalence in the general population. The civilian pilots are less affected by the career as opposed to the aviators working for the military. Even in these pilots working for the military, there are variations between the different types of planes that they operate, with the helicopter pilots being more predisposed to persistent back and neck pain⁽¹⁾.

The helicopter pilots have various factors working together to make them more prone to chronic symptoms described above. These factors include the vibrations that are frequent in-flight⁽¹²⁾. The aviators often have to wear heavy gadgets that aid them in their flight missions. These gadgets have been identified as the main reasons for the causation of the neck pain⁽⁷⁾. The distribution of neck pain in the aviators is also one of the observations in the study. The fighter pilots were more predisposed to the chronic neck pain. The blame for this observation in most of the studies is mainly on the acceleration forces that the pilots operating the fighter planes are exposed to during various periods in their flight missions.

In most of the studies, one of the consistent factors in the manifestation of chronic neck and back symptoms is the duration of flying for the different types of planes⁽⁸⁾. The study establishes that the longer the duration of flight times, the more likely that the pilots will have chronic neck and back pain⁽⁸⁾. This inference may reveal why air force pilots were more affected in relation to the civilian pilots. The air force pilots generally reported working in more stressful environment compared to their civilian counterparts, and their flight hours were longer in average. The civilian pilots also reported a higher prevalence of chronic back pain. However, chronic neck pain is more prevalent among the military aviators. In general, the prevalence of neck pain was less compared to chronic back pain.

The prevalence of these symptoms in the general population is significantly lower compared to the aviators. Therefore, there is a positive relationship between being an aviator and the manifestation of

chronic back and neck pain. There is a need to carry out further research on the individual factors that may be contributing to the increased prevalence of these symptoms. One example is the role played by training in the causation of neck pain. The acceleration forces have been the subject of many studies in the research. Nevertheless, there is still need to evaluate the different levels of acceleration and provide values below which acceleration causes little manifestation of the symptoms.

Conclusion

In conclusion, the research looked at the different causes of chronic neck and back pain in aviators. It analyzed the findings of different studies in relation to this pain in pilots. The findings indicate that the prevalence of chronic neck and back pain in the specified category of people is higher than in the general population. The civilian pilots are less likely to suffer from these symptoms. However, they also get affected. In relation to the different types of aircrafts, the studies indicate that the military helicopters and other helicopters have a higher incidence of pilots experiencing chronic neck and back pain. However, chronic neck pain was higher in fighter plane pilots, with chronic back pain being more in the helicopter pilots.

Some of the factors that were found significant in the development of these symptoms varied in different individuals and aircrafts. Tall pilots, those who flew longer hours, and those working for the military were most likely affected. Helicopters and military planes were most prone because of additional heavy gadgets on the aviators and the acceleration forces to which they were predisposed. The posturing of the aviators was another string association to chronic back and neck pain.

Some of the recommendations include the need for a plan to monitor the symptoms in pilots before and after flights. Modification of planes should also be done to suit the individual needs of the aviators. There is also need to carry out training for the pilots on the best posturing methods that they should adopt while in-flight. Some of the measures were discussed to be important in the prevention of the

development of chronic back and neck pain in aviators. There is also need for more research into the topic. This particular study will add to the growing body of evidence on the topic.

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