The Impact of Flight on Cabin Crew Wellness: A Literature Review

Ashleigh D. Roderick

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Mitchell Morrison, Ph.D.
Thesis Chair

____

James Mashburn, M.C.A.
Committee Member

____

James H. Nutter, D.A.
Honors Director

____

Date

Abstract

Since its conception in 1903, aviation has captivated the attention of people across the globe and has been utilized in many sectors of society. Aviation related occupations pose a unique set of risks to those working in the field, health risks being one of the most prominent. Cancer, cardiovascular disease, musculoskeletal ailments, and genetic damage have all been studied as potential consequences of working in the aviation industry, as some studies indicate a higher prevalence of these issues in aviation employees. Apart from physiological issues, mental health issues have also been observed in those working in aviation. Mental health issues affect military pilots, commercial pilots, and cabin crew; however, each sample displayed different ailments due to the distinctive differences in their occupations and duties. The Federal Aviation Administration (FAA) has guardrails in place to prevent adverse health affecting the safety of flight, and to protect the industry overall. However, the effectiveness of these safeguards is called into question, as most studies depicted an alarming rate of mental health issues in aviation related jobs. Contrarily, any physical health issues of the participants did not appear to be a direct consequence of flying, however they could be further agitated by partaking in it.

The Impact of Flight on Cabin Crew Wellness: A Literature Review

Aviation is a hallmark of the American lifestyle. It is present in all facets of the country, including the corporate, commercial, and military sectors. There are about 4.1 billion passenger enplanements annually, 140,000 airline pilots employed internationally, and 120,000 flight attendants employed in the U.S. alone (Toprani et al., 2020), but as often as passengers patronize these services, little consideration is given to the well-being of those that make it possible: the pilots and cabin crew staff. Pilots and flight attendants face factors that could harm their physical health, including distinct types of radiation, emissions, and toxins. There are intense sources of work-related stress (WRS), fatigue, and disruption of routine present in the aviation industry, which could contribute to the erosion of the mental well-being of cabin crews. With these pressures considered, additional scrutiny of fitness for these occupations from the Federal Aviation Administration (FAA) is administered to protect industry safety (Haldorsen et al., 2000); however, a subject of controversy is whether enough regulations are present to achieve safe flight operations. The issue in question is if the physical and mental strain from these occupations can cause long-term ramifications for the employees and the safety of the industry, and what regulatory action can be taken to mitigate the rise of health issues and subsequent crash hazards.

Physiological Health Degree of Impact

Flying poses a distinct set of physical risks to pilots and flight attendants. In fact, one of these unique factors, the changes in atmospheric pressure that these employees are exposed to, accounted for 18% of occupational injuries for flight attendants and 8% of occupational injuries for pilots in a 1988 study (Reardon, 1992). In the aviation industry, there is also definitive exposure to ionizing radiation (Nicholas et al., 2009) and cosmic radiation (Haldorsen et al., 2000). There is significant exposure to chemical or physical agents like jet fuel, engine emissions, and electromagnetic fields radiated from the cockpit instruments (Yong et al., 2009). Ozone or radiofrequency radiation are two other potentially hazardous agents (Rafnsson et al., 2000).

Circadian rhythm disruption from travelling through various time zones is also common and can put pilots at risk for many diseases (Haldorsen et al., 2000). Pilots and cabin crew also tend to work non-standard hours, which puts them at risk for fatigue or further circadian disruption (Linnersjö et al., 2011), or in extreme cases, cardiovascular strain (Wen et al., 2020). There are concerns about the incidence of cancer, cardiovascular issues, musculoskeletal issues, and genome damage in relation to these agents. Unfortunately, the risks of flying are usually assessed from the viewpoint of the passenger. The potential health risks that pilots and cabin crew members face on the job are often overlooked (Reardon, 1992).

Cancer Risks

Commercial airline pilots worldwide usually have a higher cancer risk, reporting higher incidences of brain, rectal, testicular, bladder, prostate, leukemia, non-melanoma, and malignant melanoma cancers, as well as Hodgkin’s disease (Rafnsson et al., 2000). This is concurrent with a study of 2,865 commercial airline pilots where 19% had non-melanoma skin cancer. This was presumably due to their time spent at high altitudes where levels of ionizing radiation are elevated. The levels of ultraviolet radiation drop as pilots fly at higher latitudes (higher than 55N or below 55S), but the levels of ionizing radiation increase dramatically, similar to their levels at high altitudes (Nicholas et al., 2009). Ionizing radiation is associated with non-melanoma skin cancer, and this could subject pilots to a higher risk (Nicholas et al., 2009). To extrapolate this result, a study conducted by Nicholas et al. (2009) was performed by surveying a group of pilots.

The survey covered topics such as medical history, recreational sun exposure, on-duty radiation exposure, and circadian disruptions. The skin tone, eye color, hair color, genetic predispositions, immune health, location of benign and malignant masses, age, gender, race, total flight time, time spent at 40,000 feet or higher, time spent above 55N or below 55S, night flight time, and recreational sun exposure (burns, sunscreen use, tanning, etc.) were all taken into consideration for the study (Nicholas et al., 2009).

Results

In the study by Nicholas et al. (2009), 93% of the 2,865 respondents were non-Hispanic Caucasian males, so results are solely reported for this demographic. Four hundred and sixty-two, or 19%, reported an instance of non-melanoma skin cancer, the median flight time was 20 years for this group (Nicholas et al., 2009). Six-hundred eleven of those who never had cancer had less than 20 years of flight experience, and 1,352 had more than 20 years. The study concluded that fair skin tones, severe sunburns during youth, and family predisposition to cancer were the primary non-flying risk factors of developing a non-Melanoma skin cancer. Additionally, pilots with 20 years of flight time or more had an increased risk of developing cancer if they spent considerable time at latitudes above 55N, or below 55S (Nicholas et al., 2009). Some other studies have also found that the rates of brain tumors, testicular cancer, prostate cancer, bladder cancer, and myeloid leukemia were slightly higher in pilots, while the risk of breast cancer was slightly higher in-flight attendants compared to the general population (Haldorsen et al., 2000).

To supplement these findings, another study by Rafnsson (2000) was conducted. A cohort of 458 Icelandic commercial pilots was surveyed, and radiation exposure was calculated by multiplying the units of radiation received in micro sieverts (μSv) per block hour by the number of block hours per aircraft being flown. The results depicted a significantly higher risk of malignant melanoma, as well as a slightly elevated risk of prostate, kidney, and brain cancers. There were 19 instances of cancer present in the cohort overall, which could be attributed to cosmic radiation in flight, or other external lifestyle factors (Rafnsson et al., 2000).

Minimal Evidence for Cancer Risk

Contrarily, other studies have shown that the cancer rate is comparable to the general population among commercial pilots (Haldorsen et al., 2000) and even lower than the general population among military pilots and female flight attendants (Linnersjö et al., 2011). A study by Haldorsen (2000) assessed the cancer risk in Norwegian pilots. The cohort was comprised of 3,701 male pilots flying in block hours, with 15% being 55 or older. Each aircraft has a unique estimated radiation dose, and the radiation dose rate was found by multiplying the block hours flown by the designated dose rate for the aircraft flown. The dose rates could be anywhere from 0.03 to 4.00 μSv/h (micro sieverts per hour) (Haldorsen et al., 2000).

Results

Annual pilot radiation dose rates in the study by Haldorsen et al. (2000) climbed over time, with frequent fliers being exposed to 1 mSv (millisievert, a unit to gauge cumulative radiation dosage) or more on the job. With exposure and external factors considered, 200 of the 3,701 pilots in the study had a cancer occurrence. The top types of cancer were lung and prostate, each with 25 occurrences, and malignant melanoma, with 22 occurrences (Haldorsen et al., 2000). Compared to the general population, the cancer occurrences were about the same, apart from malignant melanoma and nonmelanoma skin cancer. For all the cancers combined, there did not appear to be a strong link between radiation exposure and cancer incidence (Haldorsen et al., 2000). Although there is a known link between ultraviolet radiation and skin cancer, these types of cancers were not found on the head, neck, or hands of the pilots more often than in the general population, as these would be the body parts exposed in the cockpit (Haldorsen et al., 2000). Regardless of the demographic being surveyed, cancer risk sharply increases with age, as well as sun exposure during leisure time, which could explain these elevated results for skin cancer (Haldorsen et al., 2000).

This study did not find incidences of cancer that greatly exceeded what was expected, and it concluded that the cancer risk in this cohort was nearly the same as the general population (Haldorsen et al., 2000). Yong (2009) came to a concurrent conclusion, as there was a slightly higher risk for skin cancer, however the only cancers associated with radiation exposure were myeloid leukemia, bladder cancer, and colon cancer, and these did not appear in pilots more than the general population. Another study by Linnersjö (2011) had similar findings, displaying that the cancer risk for military pilots and female cabin crew are lower than the general population, while the cancer risk for airline pilots, navigators, male cabin attendants, and mechanics was proportional to the general population (Linnersjö, 2011).

Shift Work and Cardiovascular Disease

Shift work, which is the primary work flight personnel do, is considered a contributing factor to health problems such as higher BMI, diabetes, and cardiovascular disease (Wen et al., 2020). Additional agents such as circadian rhythm disruptions, exhaust fumes, irregular hours, and job strain can exacerbate these cardiovascular risks. For pilots and cabin crew employed before 1997, environmental tobacco smoke could also elevate the risk of cardiovascular disease, as smoking on planes was prevalent during that time (Linnersjö et al., 2011). Cardiovascular disease is a considerable ailment in other studies as well. For example, a study of Korean commercial pilots by Kim and Choi (2020) showed that the leading cause (55.6%) of medical certificate denials were due to a cardiovascular ailment (Kim & Choi, 2020), indicating a high prevalence of these types of diseases in pilots. Supporting this, coronary heart disease was the leading cause of permanent suspension for Air Force pilots from 1978-1987 (Curry et al., 2018). Contrarily, flying personnel generally have a lower rate of cardiovascular mortality, presumably because they have a heightened awareness of the symptoms due to the risk of inflight incapacitation (Linnersjö et al., 2011). Many cardiovascular diseases are also automatic disqualifiers for flight personnel (Dhaliwal & Carter, 2021), and healthy people are the typical initial recruits for aviation jobs (Linnersjö et al., 2011). This could be the explanation for the underrepresentation of cardiovascular diseases in this demographic, rather than assuming various flight related agents like exhaust fumes, shift work, or job strain pose no additional risk of cardiovascular disease.

Low Risk of Cardiovascular Disease

To counter the notions that flying is linked to cardiovascular disease, several studies have reported lower-than-expected incidence of cardiovascular mortality among pilots compared to the general population. Cardiovascular disease used to be the primary cause of permanent suspension in military pilots, but in a recent survey it only accounted for 3.4% of diagnoses, and 6.3% of suspensions (Curry et al., 2018). Another study by Linnersjö (2011) documents cardiovascular risk, specifically acute myocardial infarction (AMI) in both military and civilian aviators. The cohort was made up of 1,478 Swedish male airline pilots. It also included Swedish cabin attendants, 632 males and 2,324 females. 2,166 Swedish male military pilots were included, as well as 991 navigators and mechanics. All personnel were employed between 1957 and 1994 (Linnersjö et al., 2011). The data was extrapolated by reviewing the hospitalization and death records of the personnel and performing a statistical analysis on this information (Linnersjö et al., 2011).

Results

In the study by Linnersjö (2011), for all groups except for male cabin attendants, there was a lower proportion of all-cause deaths. For cardiovascular health specifically, the mortality in these groups was far lower than the general population. Navigators and mechanics had a 20% risk reduction, commercial pilots, military pilots, and male flight attendants had a 50% risk reduction, and female flight attendants had an extremely negligeable risk of cardiovascular mortality (Linnersjö et al., 2011). For each group examined, the incidence of AMI in each cohort was 6% or less, which would explain the low rate of cardiovascular mortality. Other factors that could explain this are the high rates of exercise, low incidence of smoking, and the recruitment of healthy people into the industry. Overall, the study found that the AMI incidence remains low even into retirement, supporting the notion that in-flight toxins or aviation-specific lifestyle factors do not raise the risk of cardiovascular disease (Linnersjö et al., 2011).

Risk of Musculoskeletal Ailments

Musculoskeletal problems are also in question due to their prevalence in flight personnel. Curry et al. (2018) examined a cohort of military pilots, and spinal issues were both the most common diagnosis and most common cause of permanent suspension, while orthopedic issues were the second most common (Curry et al., 2018). Another study by Shiri et al. (2015) corroborated these results, where nearly half of a cohort of fighter pilots reported neck pain, and a third reported lower back pain. Anywhere from 15% to 50% reported cervical disc degeneration, and 10% to 50% reported lumbar disc degeneration (Shiri et al., 2015). To expand upon this, a 1988 review by Reardon (1992) found that sprains were the most common musculoskeletal injury, accounting for 38% and 46% of total occupational injuries for pilots and flight attendants, respectively. The second most common injury was fracture, accounting for 15% of disabling injuries in pilots. For flight attendants, the second most common ailment was contusions or bruises, which was 10% of the injuries accounted for (Reardon, 1992). The sources of these injuries are varied.

Sources, Events, and Locations of Musculoskeletal Injuries

Of those that were classified in the study by Reardon (1992), the sources that caused the most injury for pilots were vehicles (22%, 49 cases), working surfaces (19%, 43 cases), and boxes/barrels/containers (12%, 27 cases). For flight attendants, the top cause was also vehicles (32%, 717 cases), then air pressure being too high or low (20%, 450 cases), and boxes/barrels/containers (16%, 363 cases). Like the source of the injury, the event in which each injury occurred was varied as well. The most likely events for pilots were falls (18%, 41 cases), overexertion (17%, 39 cases), and aircraft mishaps (10%, 22 cases). Flight attendants were most likely to experience overexertion (33%, 737 cases), being struck by an object (15%, 345 injuries), and falls (9%, 213 cases). Considering affected body parts, pilots were most likely to suffer injuries to the trunk (30%, 67 cases), the lower extremities (23%, 52 cases), or the head and neck (19%, 32 cases). Flight attendants had comparable results, with the head or neck and the trunk each making up 29% of injuries and 647 cases (Reardon, 1992). To supplement the work of Reardon (1992), another study found that musculoskeletal disorder also ranked as the top cause for a decrease in medical fitness during flight duty, accounting for 40% of such ailments (Kim & Choi, 2020). It appears that the duties that flight crew must conduct can be physically strenuous, possibly predisposing them to additional musculoskeletal issues.

No Considerable Musculoskeletal Risk

Some studies found no increased risk of cervical and lumbar disc degeneration between pilots and non-flying personnel. An analysis by Shiri et al. (2015) reviewed 27 studies regarding musculoskeletal problems in fighter pilots. A variety of different aircraft were surveyed, including various fighter jets, cargo planes, and helicopters. The age of the pilots, the total flight time, along with personal factors were examined in the analysis. The results concluded that fighter pilots were not at an increased risk of these musculoskeletal ailments compared with non-flyers, or other types of pilots like cargo or helicopter (Shiri et al., 2015). The reported neck pain and lower back pain could be attributed to the high G-forces that fighter pilots are exposed to, as fighter pilots can often pull G's above 7Gz, and even up to 9Gz. Most of the flight time is done at 2Gz at a minimum. The awkward neck postures and heavy helmets fighter pilots wear may be contributing factors as well. While this may cause more minor aches and pains, it does not pose an increased risk for serious lumbar or cervical disc degeneration (Shiri et al., 2015).

Compromising the Integrity of the Genome

The effect of radiation on the genome is likely the most dangerous of all the debated conditions, as it not only affects the flight personnel, but it has the potential to impact their future offspring as well. In these studies, the term genome refers to human DNA, specifically the chromosomes. Research has suggested that flight attendants may suffer reproductive health consequences due to radiation exposure (Anderson et al., 2014) and other studies have highlighted increased genome translocation frequency in pilots as they attain more flight experience (Barish, 2009). Some strides have been made to raise awareness about solar particle events and radiation dosages that could cause harm. The FAA has released a CARI software, a computer program that assesses radiation risk on a flight-by-flight basis. The FAA has also created a solar particle alert system in certain aircraft to notify crew if there is a present dosage risk (Barish, 2009). Additionally, the European Union requires air carriers to educate their employees about the recommended radiation dosages, as well as the potential health consequences for exceeding those doses (Barish, 2009). While this modern technology may be helpful, it does not actually reduce radiation risk, it only raises awareness about its presence.

Lack of Industry Concern in the U.S.

For decades, there have been known risks regarding exposure to cosmic radiation and solar particle events, and flight crews are exposed regularly. In fact, some airline pilots experience radiation exposure exceeding 6 mSv (millisieverts) per year, nearly 4 to 12 times the recommended maximum (Barish, 2009). The FAA has attempted to create advisory publications, computer programs, educational materials, and other tools to raise awareness about radiation exposure and its harmful effects. Despite this, air carriers take the problem rather lightly (Barish, 2009). No airline in the United States has implemented any training or educational programs on radiation for their employees. Only one U.S airline has created an informational document about radiation exposure available upon request (Barish, 2009).

The FAA maintains that educational materials will be voluntary for airlines to use, and it is up to employees to put pressure on their employers to enact the appropriate training (Barish, 2009). Some agencies have attempted to appeal this, such as the Association of Flight Attendants (AFA), as they requested that the FAA mandate airlines to provide education on radiation. The FAA declined this motion, despite knowing the cancer and translocation risks associated with radiation (Barish, 2009). Contrary to the United States, the European Union has taken an aggressive approach, mandating that airlines provide education about radiation. With solar cycle 23 producing some of the greatest solar particle events to date, the FAA’s failure to act and the noncompliance of the airlines could be creating undue risk of exposure for flight employees (Barish, 2009).

Factors that could cause DNA Damage

According to Toprani (2020), human DNA can suffer direct or indirect damage from the agents that flight crews are exposed to on the job, and some studies indicate that pilots or flight attendants are at a higher risk of compromised genome integrity. The cosmic radiation that these crews are exposed to could pose a reproductive risk, while the ionizing or ultraviolet radiation could increase the incidence of cancer. Additionally, some viral infections can also damage genome integrity, which flight crews are at an increased risk of due to their exposure to high volumes of people (Toprani et al., 2020). RNA viruses specifically, like COVID-19, can trigger a DNA damage response, apoptosis, unregulated cell cycles, and DNA replication stress. This can be mitigated by consuming antioxidants, which reduce the viral induced production of free radicals in the body (Toprani et al., 2020).

Reproductive Effects in Flight Attendants

The risk of DNA damage in flight that could subsequently cause reproductive effects in the flight crew is caused by cosmic radiation exposure and solar particle events. These agents are products of coronal mass ejections, solar flares, and supernova explosions that occur in space (Anderson et al., 2014). While these events occur far away, residual effects between 10^6 to 10^{20} eV (units of cosmic particles) can be detected in the troposphere, where most airline flights take place. Anderson et al. (2014) conducted a study of 2,174 female flight attendants aged 18 to 45 to see if these galactic events posed a risk of exceeding recommended radiation doses. Overexposure to radiation is suspected to cause spontaneous abortion, menstrual dysfunctions, reduced gestational period, premature birth, and reduced birth weight for those who were pregnant (Anderson et al., 2014).

The flight attendants were split into two groups, study period A (August 1st, 1992-July 31st, 1996) and study period B (November 1st, 1999-April 30th, 2001). For solar particle events, the NAIRAS (Nowcast of Atmospheric Ionizing Radiation for Aviation Safety) model was used, as it considers atmospheric density, altitude, and theoretical radiation transport calculations (Anderson et al., 2014). A computer program called CARI-6P was used to estimate total absorbed radiation (in μGy) and effective radiation dose (in μSv) from cosmic radiation events. 1,692,691 short segments of these flights were assessed for group A, and 461,536 for group B. For the time periods studied, study group A had two dose-significant solar storms, while study group B had five. These storms made 1,411 of the flight segments for period A a dose risk, while 6,593 flight segments in period B posed a dose risk (Anderson et al., 2014).

Results

In study period A, which was the first interval from August 1992 to July 1996, the average total absorbed radiation and effective radiation doses were 6.5 μGy and 18 μSv. For the study period B, the interval from November 1999 to April 2001, this was 3.1 μGy and 8.3 μSv (Anderson et al., 2014). At the peak, dose rates reached 440 μGy, or 1.2 mSv (Anderson et al., 2014). For reference, the National Council on Radiation Protection (NCRP) recommends less than 0.5 mSv in radiation exposure per month, particularly for pregnant women (Anderson et al., 2014). In sum, an exceedingly small proportion of flights meet the criteria for high radiation exposure. But the flight crew, especially those who are pregnant, could be grossly exceeding the radiation minimum if they happen to fly through one of these events, raising the risk for undue harm. To mitigate this, flying at lower altitudes and latitudes, as well as reducing the amount of time in the air, can greatly lower exposure rates (Anderson et al., 2014).

Genome Unaffected

A study by Yong (2009) probed into the likelihood of genome damage in pilots. The study cited that prior data suggested a slight link to chromosome aberrations in flight crew, more so than those who do not fly. Curiously, the finding did not apply to flight attendants. So, the cohort was comprised of 83 white male pilots and 50 comparison subjects who smoked infrequently or never, had no cancer history, were between age 35 to 56, and had no history of chromosomal disorders or underlying diseases (Yong et al., 2009). Blood samples were taken from each subject to test for translocations and anomalies using the fluorescence in situ hybridization (FISH) method. The results were given in 100 translocation frequencies per cell equivalents (Yong et al., 2009).

Results

In the study by Yong et al. (2009), as the age of the pilot increased, the translocation rate increased, and this was true in the comparison subjects as well (Yong et al., 2009). The overall rate of translocation for pilots was 0.39 translocations per 100 cell events, compared with 0.32 for non-pilots. After accounting for age and adjusted mean translocation frequency, there was no higher prevalence of dicentrics, rings, or other translocations between flyers versus non flyers, yielding translocation rates of 0.37 and 0.38, respectively. Within the pilot group, higher flight time also yielded an increased translocation rate. This could suggest that increased flight time raises the risk of translocation, but the group surveyed was not large enough nor broad enough to say this definitively (Yong et al., 2009).

Conclusion

In terms of physical health, aviators are in generally good shape, given that the all-cause mortality is low for all groups (Linnersjö et al., 2011). To exhibit this, male airline pilots, female flight attendants have a 40% lower risk of premature mortality compared to the general population, and for male military pilots this rate is 25% lower than the general population. With aircraft accidents excluded, these statistics can be up to 15% lower for these groups (Linnersjö et al., 2011). All research considered, there is not enough evidence to produce a definitive link between flight and physiological health problems, particularly for cardiovascular risk, as there is very little connection between aviation jobs and cardiovascular mortality (Curry et al., 2018, Linnersjö et al., 2011). There is marginally more evidence in support of skin cancer risk, musculoskeletal risk, and genome damage due to the potential exposure to radiation in the cockpit (Yong et al., 2009), as well as the high incidence of minor muscle problems in pilots (Shiri et al., 2015), but still not enough to inexplicably link the two.

Psychological Health Degree of Impact

Military pilots, commercial pilots, and flight attendants experience high degrees of work-related stress (WRS) due to industry pressures, but the subject of controversy is whether this occupational mental strain can cause permanent mental health issues. In the overall U.S population, 18% of people reported some form of a mental issue in 2016, with 4% having a serious mental illness. Less than 45% of this group pursued treatment for their mental issues (DeHoff & Cusick, 2018). It would make sense that the pilot population exhibits similar trends to the general population, especially due to the fears that pilots have regarding mental health reporting. This is especially true because reporting a mental issue could lead to potential job consequences for pilots (DeHoff & Cusick, 2018). Note that each of these career paths have their own duties, demands, and unique challenges; military pilots often see combat, civilian pilots bear the burden of being responsible for hundreds of passengers daily, and flight attendants are also responsible for passenger well-being. Hence why they should not be conflated amongst each other, nor should sweeping generalizations be applied to all three of them.

Present Mental Health Issues in Military Pilots

U.S. military pilots often fly under difficult operational conditions and face many operational stressors, which could potentially increase their propensity for psychiatric disorders. These include long hours, minimal recovery time, prolonged flight in instrument meteorological conditions (IMC), combat scenarios, and task saturation from flying complex aircraft (Britt et al., 2018). While the incidence of behavior health and mental health conditions for U.S military pilots is on the decline, perhaps due to the reduction in overseas deployments, there is still a substantial number of mental disorders in this demographic (Kieffer & Stahlman, 2021). The military encourages a unique set of coping mechanisms for their pilots, including stress inoculation training, stress management techniques, and critical incident stress debriefings (Cahill et al., 2019), and the rise of these strategies may also be helping with the decline of mental health issues in military personnel.

Common Disorders

Stress, PTSD, and sleep disorders are quite common ailments in U.S military pilots (Kieffer & Stahlman, 2021). In U.S military personnel, symptoms of major depressive disorder occurred in 12% of deployed personnel, and 13% of previously deployed personnel (DeHoff & Cusick, 2018). The Army, for example, maintains a strict set of standards to deem crewmembers fit for duty, and mental health disorders are closely monitored due to the high prevalence of them (Curry et al., 2018). Curry (2018) performed a study on suspensions in the military. Regarding

100 cases of PTSD, all of them resulted in a suspension. Psychiatric disorders like PTSD or anxiety were the most common cause of the permanent suspension of military pilots, accounting for 28.2% of suspensions, and appearing nearly twice as much as other causes (Curry et al., 2018). Approximately 6 percent of remote Air Force pilots met the criteria for PTSD, also supporting this notion (Kieffer & Stahlman, 2021). Supporting this assertion, in the interval between 2003 and 2019, the instance of mental disorders in U.S Air Force personnel increased from 49.2 per 1,000 person-years to 76.9 per 1,000 person years. Additionally, pilots and other personnel had increases in the instance of sleep disorders over this period, and report high rates of sleep disorders or fatigue overall (Kieffer & Stahlman, 2021).

In a study of 1,155 U.S military aviation personnel with at least one diagnosed mental disorder, nearly a quarter of them (21.8%) had an added diagnosis (Britt et al., 2018). The leading diagnostic code for military aviators who had more than one disorder was adjustment disorder (527 aviators, 38%), with posttraumatic stress disorder (PTSD) being second (298 aviators, 21.5%). Other common psychiatric issues were anxiety disorders (291 aviators, 20%) and depressive disorders (271 aviators, 19.5%). For aviators that only had one disorder, the same four categories in order were the top ailments, with the percentage breakdown being adjustment disorders as 45.4% (396 aviators), PTSD as 19.7% (172 aviators), anxiety as 19% (166 aviators), and depressive disorders as 15.8% (138 aviators) (Britt et al., 2018). The leading diagnostic category for health issues were those that are psychiatric in nature. In these 1,387 instances, 60.9% were able to obtain a waiver after getting help, and 39.1% were suspended (Britt et al., 2018). The likelihood of these diagnoses increased with experience, as did the chance of suspension due to a disorder (Curry et al., 2018).

In sum, military aviators still display a high prevalence of mental ailments like PTSD, anxiety, or depression, despite the overall incidence of these disorders declining in this demographic. A greater focus on mental health needs to be emphasized in the military, as many struggling personnel need aid. Even if a mental issue is reported, the statistics show that many can obtain waivers and resume their careers as usual, posing less of a risk of long-term career loss.

Present Mental Health Issues in Civilian Pilots

Pilots are at an elevated risk of developing mental health problems due to many factors. Some of these factors include work related stress (WRS), heavy workload, undesirable hours, check rides, being away from home, among many others (Mulder & de Rooy, 2018). This is supported by the findings in a workshop by Cahill (2020), as every single participant reported well-being problems, most commonly citing WRS as their source of mental angst. Also, 8.08% of the pilot participants in the workshop reported a mental illness so great that they were unfit for flight (Cahill et al. 2020). Many mental health related aircraft accidents that occur are due to negative life events in the pilot’s life. Chronic illnesses, family relational problems, unemployment or financial strain, and interpersonal loss are some of the commonly cited causes (Mulder & de Rooy, 2018). As negative life events are a potential contributor for mental health issues or suicidal tendencies in the general population, it would make sense that this would be the case for pilots as well. A higher volume of peer support programs and increased mental health screenings can help reduce the risk of suicidal tendencies in flight personnel. Discussion about negative life events during these medical screenings and reducing the overall stigma when it comes to reporting these issues can also encourage reporting and help create a safer aviation industry (Mulder & de Rooy, 2018).

Common Ailments

Civilian pilots exhibited similar mental health results to military pilots, as 13.5% of commercial airline pilots met the threshold for depression, and 4.1% stated that they had suicidal thoughts in the past two weeks, according to a PHQ-9 questionnaire (Mulder & de Rooy, 2018). Another systematic review of twenty studies showed remarkably comparable results. The occurrence of major depressive disorder was up to 12.6%, 12.8% of participants met the threshold for clinical depression, and 7.9% had suicidal thoughts in the previous two weeks (Cahill et al., 2020). Another anonymous study of 1,837 commercial pilots depicted synchronous results, where 12% of respondents could be classified as depressed, and 4% admitted to having suicidal thoughts in the past two weeks. Alarmingly, over 13% of these pilots had flown commercial airliners in the preceding 30 days (DeHoff and Cusick, 2018).

In addition to depression, stress has a significant impact on pilots as well; in a study of 424 pilots, stress had notable negative impacts to their mental health. Extraneous factors such as organizational culture, career development, workplace autonomy, and family support were important for mental well-being, but could also produce undue stress if they were not managed properly (Vuorio & Bor, 2020).

Pilot Suicide

Pilot suicide via an aircraft tends to be an uncommon occurrence. In general aviation, 0.33% of fatal crashes instance of suicide by aircraft, or 24 out of 7,244. Pilot murder-suicides are even less common, only occurring six times over the last three decades (Vuorio & Bor, 2020). Vuorio and Bor (2020) claimed that the suicide risk and mental issues arising in flight personnel were due to traumatic world events rather than the occupation itself, supporting the notion that flying does not negatively impact mental health. The fact that suicide risk by aircraft in the post 9/11 era increased to four times the prior national average supports this idea (Vuorio & Bor, 2020). Global catastrophes create undue financial stress, pilot groundings, redundancy, and changes in employment contracts. While flying itself does not appear to be the cause of pilot suicide, the potential damage that a suicidal pilot could inflict warrants action. Medical examiners should be keeping an eye out for distress, symptoms of depression, hopelessness, and traumatic life events in pilots. Proper education on stress management, emotional coping mechanisms, and therapy can eliminate much of the suicide risk (Vuorio & Bor, 2020).

Present Mental Health Issues in Flight Attendants

Flight attendants face a unique set of mental health challenges. Historically, they struggle with psychiatric issues, including greater degrees of stress, anxiety, and sleep problems. The on-call duty, time pressures, and bodily demands of cabin crew work worsen these mental issues (Görlich & Stadelmann, 2020). The circadian rhythm is also disrupted in flight attendants, as they tend to have late nights and early mornings back-to-back, long hours, irregular schedules, and jet lag from consistently switching time zones. The lengthy list of air disasters contributes to the presence of anxiety in flight attendants, with at least 37% of cabin personnel feeling anxious before or during takeoff (Görlich & Stadelmann, 2020). The findings on the mental state of cabin attendants are varied, with one study declaring that their emotional exhaustion tends to increase with age, as well as their emotional dissonance (Görlich & Stadelmann, 2020), however another study claims that the instance of depression decreases with age (Wen et al., 2020).

Common Ailments

In a study by Wen et al. (2020), the history of depression in flight attendants was found to be at least twice that of the general population, with 40% of the cohort reporting symptoms, and the same percentage of the cohort having a substantial risk of major depressive disorder (Wen et al., 2020). To supplement this, a study by Görlich & Stadelmann (2020) examined the mental health of flight attendants in two different samples, a survey done in May 2019 and a survey done in April 2020. The general data for both groups is considered, as well as any mental health changes that occurred with the onset of the COVID-19 pandemic. The federal and voluntary regulations imposed due to COVID-19 pandemic resulted in furloughs for many airline employees, creating financial stress and increasing the likelihood of depression, anxiety, or mental distress (Görlich & Stadelmann, 2020).

Given that flight attendants are the largest cohort of aviation employees, their response to the pandemic is significant. For these aforementioned surveys done by Görlich & Stadelmann (2020), survey 1 interviewed 105 flight attendants from 12 airlines, and survey 2 interviewed 1,119 flight attendants from 22 airlines. Most respondents were female, survey 1 contained 68.6% females, and survey 2 contained 81.9% females, but age, gender or other demographic information did not significantly influence the results (Görlich & Stadelmann, 2020). A DASS-21 (Depression and Anxiety Stress Scale) was used to garner responses, where respondents rated each statement on a scale of 0 (did not apply) to 3 (applies strongly). In the May 2019 survey, clinically significant depression or stress appeared in 8% of respondents, while clinically significant anxiety appeared in 6% of respondents. This jumped in the April 2020 survey, where clinically significant depression, anxiety, or stress appeared in 23% of, 14%, and 24% of respondents, respectfully (Görlich & Stadelmann, 2020). These results were far beyond what the control group reported, exceeding it by 14-20%. This could be attributed to the fears of job loss due to the pandemic, as 66% of respondents feared or partly feared this. Also, many respondents (73%) had their personal or financial situation worsen due to the pandemic, which could correlate to the onset of mental health problems.

Work plays a significant role in psychiatric health, fulfilling several different purposes: time structure, social status, social interaction, social integration, and sense of purpose (Görlich & Stadelmann, 2020). Given that the COVID-19 pandemic hit the airlines hard and stripped many employees of the benefits that work provides, it would make sense that the mental health of flight attendants has deteriorated recently, with most of the respondents who lost their jobs reporting higher levels of depression and stress (Görlich & Stadelmann, 2020).

Sleep Issues

As previously stated, flight attendants perform a disproportionate amount of shift work. This can disrupt the sleep schedule and circadian rhythm, and it can contribute to the development of mental health issues or insomnia. Flight attendants tend to report higher degrees of fatigue compared to their counterparts, with about a third reporting some type of sleep disorder (Wen et al., 2020). In a study by Wen et al. (2020), as many as 84% report being fatigued while on duty. Additionally, 37% of cabin attendants pursued medical help for fatigue problems over the course of a year, and 71% felt that they could not perform as safely as usual (Wen et al., 2020). This statistic likely reflects reality, as it was found that half of surveyed flight attendants fell asleep on shift or while driving home after a shift during a given month (Wen et al., 2020). The study by Wen (2020) aimed to confirm the prevalence of sleep issues or fatigue in cabin attendants through an online survey.

The survey questions were rated from 1 to 7, with 1 being “1: Fully alert; wide awake, extremely energetic” to “7: Completely exhausted; unable to function effectively” (Wen et al., 2020, p. 4). The questions asked were related to caffeine intake, instances of falling asleep at work, and safety effectiveness on shift. In the final analysis, 930 of the survey responses were used. Of the respondents, 12.4% reported excessive fatigue, and 14.6% reported excessive sleepiness (Wen et al., 2020). Sixty-eight percent had an elevated risk of shift work disorder (SWD), which is categorized by circadian rhythm disruptions being caused by an occupation. Additionally, 78.2% had fatigue to the point that safety was affected, 34.8% had fallen asleep on-shift over the last month, 57.7% met the criteria for insomnia, and 41.4% had used alcohol to induce sleep recently (Wen et al., 2020). Given that flight attendants need to be vigilant and alert in the event of an inflight emergency, excessive amounts of fatigue are detrimental to safety. Wen et al. (2020) suggests an intervention program to reduce shift work incidence and encourage a reduction in alcohol or caffeine consumption, as these can hurt the regulation of the sleep schedule.

Improved Mental Health in Flight Attendants

Contrary to the prior data, some research shows that mental health could be improving for flight attendants under some circumstances. The study by Görlich & Stadelmann (2020) found that the flight attendants who showed clinically relevant symptoms of anxiety, depression, and stress in the May 2019 survey tested at rates at or lower than the control group of healthy, normal students. For flight attendants who continued to fly during the pandemic, the mean value of depression and stress was reduced as well (Görlich & Stadelmann, 2020). This might suggest that the occupation does not contribute to mental health problems, and instead there is a more age-related demographic issue, or the mental issues could be related to larger societal trends like pandemics (Vuorio & Bor, 2020). The incidence of depression in flight attendants decreased 0.02 units on the undiagnosed depression patient health questionnaire (PHQ-2) for each year of age, and they only reported mild fatigue on average. Such ailments are experienced by other occupations frequently, and this challenges the notion that flying is the cause (Wen et al., 2020).

Conclusion

Interestingly, the studies shown do offer downsides, like the high prevalence of disorders in flight personnel. However, many describe a positive aspect, like the high likelihood of obtaining a waiver if a mental issue is present (Britt et al., 2018), or the fact that flight attendants show improved signs of mental health in some studies (Görlich & Stadelmann, 2020, Wen et al., 2020). There are valid points about the effects of age and contemporary world issues on the mental health of flight personnel (Vuorio & Bor, 2020), but they are not enough to refute the evidence that depression, anxiety, PTSD, and other disorders exist among these occupations, especially due to the irregular work hours, task saturation, and extraneous stressors that occur. Although further research is needed to make a definitive claim, it appears that occupations related to flight could contribute to the development of mental health problems like PTSD, stress, depression, anxiety, or sleep disorders in pilots and flight attendants.

Implications on Industry Safety

The safety of aviation is dependent on the capability and well-being of those working in the field. Because of this, the FAA has stringent standards in place to prevent the psychological and physical incapacitation of pilots, to protect their individual safety and that of the passengers as well. The downside to the FAA examinations and screening is that it is often subjective, relying on the self-reports of the individual pilot or the personal criteria of the examiner (DeHoff & Cusick, 2018). However, the FAA has rigid medical standards that examiners are to abide by, so there should be a consensus on what conditions are considered safe and acceptable, versus conditions that are unsafe and could incapacitate the pilot (Dhaliwal & Carter, 2021).

Federal Regulations for Fitness

To be a pilot, one must show impeccable physical and mental fitness. They are required to have a valid medical certificate, and they are often under close supervision, especially as they age (Haldorsen et al., 2000). Since the requirements are so demanding, in 1944, the International Civil Aviation Organization (ICAO) decided that international aviation practices must be standardized regarding medical certifications. In doing this, the goal of ICAO was to have a sub-1% risk of pilot incapacitation annually, and this was the standard that would guide medical examinations and pilot certification (Dhaliwal & Carter, 2021). Incapacitation was chosen as a baseline because it is detrimental to flight, and it can be brought on by many common ailments, including gastrointestinal issues, earaches, faintness, headaches, and vertigo. Incapacitation can be caused by more serious issues such as drug usage or cardiac defects, so these are screened for as well. While the medical examinations primarily serve to assess the physical health of the pilot, some parts of the exam assess mental health as well (DeHoff & Cusick, 2018). Although the regulations for civilian and military pilots are similar, military pilots are subject to additional testing as they may face combat scenarios, making the risk of incapacitation even more dire (Dhaliwal & Carter, 2021).

Disqualifiers

Per the FAA, all pilots must possess an approved medical examination by an Aviation Medical Examiner (AME), with very few exceptions to this rule. The AME, under the direction of the FAA, probes into the history of each applicant to ensure that no disqualifying conditions are present (Dhaliwal & Carter, 2021). Any conditions that cause vertigo, disorientation, or speech issues are automatic disqualifiers for a pilot certificate, as is any current presence of substance abuse, psychosis, bipolar disorder, severe depression, suicidal ideations, or severe personality disorders. The prospective pilot must also have adequate distance vision and near vision, hearing, cardiovascular health, and mental stability (Dhaliwal & Carter, 2021). While some of these conditions are absolute, others are more subjective and are left to the discretion of the AME. From there, the AME must choose to issue the certificate, not issue, or defer it (Dehoff & Cusick, 2018).

Medical Classes

There are three classes of medical certificates that pilots can obtain, they are first, second, and third (Dhaliwal & Carter, 2021). The class of certificate issued depends on the type of privileges the pilot will exercise. Airline Transport Pilots (ATPs) must have a first class medical, and this is valid for 12 calendar months for pilots under 40 years old, and 6 calendar months for pilots over 40 years of age. Commercial pilots must have a second class medical; this is valid for 12 calendar months regardless of age. Finally, private pilots must have a third class medical, and this is valid for 60 calendar months for pilots under 40, this scales back to 24 calendar months for pilots over 40 (Dhaliwal & Carter, 2021).

Ophthalmology: Distance Vision, Near Vision, and Color Vision Requirements

Civilian pilots must have 20/40 or better for their near vision, and 20/20 or better for their distance vision (for private pilots, this is 20/40), and these can be corrected or uncorrected (Dhaliwal & Carter, 2021). For the military, near vision and distance vision must be corrected to 20/20 in nearly all circumstances, with requirements for uncorrected vision varying among the branches. Minor refractive errors such as myopia, hyperopia, and astigmatism are acceptable for the military, but they must be corrected with glasses (Dhaliwal & Carter, 2021). Color vision is also important for pilots and is a requirement to fly. Pseudoisochromatic Plates (PIP) are used by the FAA and the military to assess color vision, an aviator must perceive 12 out of 14 correctly to pass. Other tests used by the military include the Waggoner CCVT, Color Assessment & Diagnosis, and Cone Contrast Test (CCT). Special attention is given to red and green vision, if the pilot does not test well on these, it is flagged as a color deficiency (Dhaliwal & Carter, 2021).

Ear, Hearing, and Audiology

Table 1: Navy, Army, and Air Force Audiometric Standards

Frequency	500 HZ	1000HZ	2000HZ	3000HZ	4000HZ
Navy	25db	25db	25db	45db	55db
Army	25db	25db	25db	35db	45db
Air Force	25db	25db	25db	35db	45db

Table 2: FAA Audiometric Standards

Frequency	500HZ	1000HZ	2000HZ	3000 HZ
Better Ear	35db	30db	30db	40db
Worse Ear	35db	50db	50db	60db

Figure 1: *FAA and Military Audiometric Standards* (Dhaliwal & Carter, 2021).

Any ear condition that is related to vertigo, equilibrium disturbances, or speech issues is prohibited by the FAA and the military. Such conditions that fall into these categories and are not eligible for waivers include Meniere disease, benign paroxysmal positional vertigo, chronic sinusitis, unrepairable cleft palates, or speech deficits (Dhaliwal & Carter, 2021). For hearing requirements, all military pilots are subject to an audiometric test. Civilian pilots are offered more leniency, as an audiometric test or a basic hearing exam can fulfill the requirement. The basic exam includes the hearing of a normal voice in a quiet room, with the pilot six feet away and turned away from the examiner. The audiometric limits are stricter for the military, whereas civilian pilots only need the ability to hear radio transmissions or warning noises in the cockpit (Dhaliwal & Carter, 2021).

Heart Health Requirements

The FAA and the military begin to keep a close eye on the heart health of pilots as they get older (Dhaliwal & Carter, 2021). At 35 years of age, all civilian pilots must submit to their first ECG. At age 40 and up, this becomes an annual requirement. For the military, pilots must get an ECG every five years after age 25, and every year after age 50. Some anomalies in an ECG are considered acceptable, such as sinus bradycardia, or first-degree AV block. Other ECG deviations, such as second-degree AV block or third-degree AV block are automatic, non-negotiable disqualifiers (Dhaliwal & Carter, 2021). In addition to ECG's, the pulse rate and blood pressure of pilots are also examined. For the FAA, a pilot may not have a pulse rate lower than 50 beats per minute (bpm), unless they can prove that no coronary ailments are present. As for the military, the Army and the Navy disqualify those with tachycardia, a heartbeat over 100 bpm (Dhaliwal & Carter, 2021). The Navy disqualifies pilots who exhibit 45 bpm or less unless cardiac disease can be ruled out. The Army has no established lower limit, and the Air Force has no established limits at all, but both branches reserve the right to disqualify if there is evidence of arrhythmias (Dhaliwal & Carter, 2021). As for blood pressure, hypertension is not an immediate disqualifier. The FAA permits pilots to have a maximum reading of 155/95 mmHG, while the military permits a maximum reading of 140/90 mmHG, despite both being hypertensive values. The FAA approves most blockers, diuretics, and inhibitors, while the approved medication list for the military is far more limited (Dhaliwal & Carter, 2021). However, the military does permit thiazide diuretics, angiotensin-converting enzyme inhibitors (ACE-I), and angiotensin II receptor blockers (ARB). There is a grounding period after starting these medications to rule out any side effects. For civilian pilots this is seven days, and for military pilots this is 30 days (Dhaliwal & Carter, 2021).

Mental Health Requirements

Many mental health issues are disqualifying for both military and civilian aviation. Severe psychosis, bipolar disorder, severe depression, suicidal ideations, and personality disorders are disqualifiers not eligible for waiver in military or civilian aviation (Dhaliwal & Carter, 2021). Minor conditions, such as mild depression, anxiety, or grief are not disqualifying, but may require some form of therapy to mitigate the effects and allow the pilot to continue flying (Dhaliwal & Carter, 2021). Most psychiatric medications or selective serotonin reuptake inhibitors (SSRIs) are not permissible for aviators. However, medical certificates and waivers may be issued if the pilot can prove that they have discontinued medicine, completed therapy, and have been stable for six months (Dhaliwal & Carter, 2021). This is evaluated on a case-by-case basis, and the requirements are stricter for military aviators, but these are the general mental health guidelines.

Drug Usage

The FAA and the military have no tolerance for substance abuse. Any history or diagnosis of alcohol or illicit drug (opioids, amphetamines, marijuana, cocaine, etc.) abuse is a disqualifier, unless there has been a documented two-year abstinence period and the abuse has been discontinued (Dhaliwal & Carter, 2021). While the term “substance abuse” is open to interpretation, the generally recognized diagnoses for substance abuse include medically documented case history with the substance, using the substance in a physically hazardous situation (ex: DUI/DWI), a positive drug test or a blood alcohol concentration (BAC) test of 0.04 or greater, or denial of a breathalyzer and/or drug test (Dhaliwal & Carter, 2021).

It is a given that illegal drugs or alcohol abuse can disqualify a pilot, but there are many legally prescribed drugs that are not permissible. There are two types of medications that are significant in an aeromedical context, “Do Not Issue” medications and “Do Not Fly” medications. Do Not Issue medications forbid an aviator from receiving a medical. Medications used to treat angina, seizures, diabetes, and anticholinergics are a few examples of Do Not Issue medicines (Dhaliwal & Carter, 2021). In most cases, Do Not Fly medicines do not disqualify a pilot permanently. However, the pilot must wait five times the half-life or maximum time interval of the medication until they fly again. Many cold medicines or nasal decongestants are examples of Do Not Fly medicines (Dhaliwal & Carter, 2021).

Waivers and Reluctance of Reporting

Many aviation employees are unwilling to report health issues due to the stigma surrounding them, and the threat of job loss. Many people in the aviation industry are predisposed to hazardous attitudes like “macho” or “invulnerability” that may discourage them from reporting mental problems they may have (DeHoff & Cusick, 2018), and this results in many not getting the help they need (Britt et al., 2018). Despite the hesitance to report, proactively acquiring treatment for a mental health issue is associated with better outcomes in the long run, especially regarding minor problems (Britt et al., 2018). Obviously, aviators who are experiencing suicidal thoughts or are actively trying to attempt suicide should have their privileges restricted for the sake of flight safety. However, aviators who have minor mental issues that do not directly impact flight safety and those who have coping strategies to deal with these mental issues, should be able to come forward without the risk of consequence (Mulder & de Rooy, 2018).

Even if a pilot is not facing the threat of career loss, the steps that follow reporting a mental health concern are very tedious. This discourages pilots from reporting and getting the help they require (DeHoff & Cusick, 2018). Fortunately, reporting a health issue for the safety of the crew does not always lead to suspension. For example, out of 14,552 requested medical waivers, 14,184 were granted in a study by Curry et al. (2018). In other studies, waivers continue to be granted most of the time. In a 5-year study by Britt et al. (2018), a waiver was granted in 55.3% of cases, and in 44.7% of cases the pilot was suspended. In another instance, 214 U.S Air Force personnel were hospitalized and restricted from flying due to mental health concerns. After treatment, 138 of them (64%) were issued a waiver and were able to continue flying within the following year or two (Britt et al., 2018). While there is often a 3-to-12-month period after waiver approval where a pilot cannot fly, this does not mean that their career is in jeopardy, and pilots should feel that they can come forward as long-term consequences are not always a factor (Kieffer & Stahlman, 2021).

Neglect of Health Issues

The clinical significance of the aforementioned information is that it recognizes the relationship between pilot health and flight safety. However, some issues go unnoticed as highlighted by Cahill (2020) and others: “feedback indicates that pilots often normalize the problems that they are experiencing, and many may not even realize that they have problems” (p. 527). Neglected issues indicate a risk not recognized, which can be dangerous for all people on board an aircraft, and even those on the ground if an accident were to occur. There are documented cases of these issues impacting flight safety. According to Mulder and de Rooy (2018), in the past 35 years, there have been 17 mental health related aviation accidents with nine of them being responsible for 576 fatalities. In four of these accidents, the pilot had developed acute psychosis, and three of these accidents had pilots on board who were experiencing psychotic symptoms. Some common examples of such accidents include JetBlue Flight 191, Malaysia Flight 370, and Germanwings Flight 9525 (Dehoff & Cusick, 2018). Other causes of these accidents include anxiety attacks (2 accidents), psychoactive substances (1 accident), and acute mental distress (1 accident). Some other speculated causes for these accidents are lovers’ quarrels, marital problems, family death, financial stress, or other negative life events (DeHoff & Cusick, 2018).

Negative life events can increase the risk of mental health complaints, suicidal thoughts, and suicide attempts. Therefore, a greater focus should be put on supporting pilots when they go through these situations (Mulder & de Rooy, 2018). The same support should be applied to physical health concerns as well, given that these conditions can eliminate the career of flight personnel or impact their ability to fulfill their duties. At times, pilots may be hesitant to report a health issue in fear of losing their career. In other cases, some minor issues could also be a matter of inexperience or lack of training, as a sizable portion of injuries occur in the first few years on the job. As an example, in a 1988 study by Reardon (1992), 11% of flight attendants and 20% of pilots experiencing a medical issue had been employed for less than one year. Twenty-two percent of injured flight attendants and 25% of injured pilots had been employed for two or three years (Reardon, 1992). Neglecting the problems, regardless of what is causing them or who is neglecting them, does not promote just culture or flight safety. Improving the reporting system for mental and physical health issues is critical to keeping flying safe and efficient for all.

Lost Workdays and Illness Rates

The Monthly Labor Review by Reardon (1992) expanded upon the issue of neglect by showing a disregard for safety on a systemic, rather than individual, level. The rate of occupational disease and injury, such as fractures, bruises, sprains, and illness, that pilots and flight attendants experienced compared to private sector workers was excessive. In a study of 100 full-time workers in 1988, airline employees had an illness rate of 13.0%, and a lost workday case rate of 7.6%. Comparatively, the private sector average was 8.6% for illnesses, and 3.5% for lost workday cases (Reardon, 1992). The airlines averaged 130.1 lost workdays, nearly double the number of lost workdays for private sector employees, which was 76.1. Per lost workday case, the number of lost workdays per employee jumped from 11 lost workdays to 17 lost workdays in the decade succeeding airline deregulation (Reardon, 1992). Unrelated to this study, Kim and Choi (2020) found that mild respiratory and digestive disease accounted for 82% of the prevalence of illness, and 68% of sick days in 5,400 sick leaves taken by airline employees, which could be another indicator of the high prevalence of occupational health issues. Psychiatric and cardiovascular disease also accounted for a sizable portion of lost workday cases in this study (Kim & Choi, 2020).

These alarming accident and illness statistics can be attributed to airline deregulation post-1978, which brought about increased industry pressures to be faster and simultaneously reduce costs, resulting in poorly enforced safety procedures, as well as the neglect of health issues in the employees (Reardon, 1992). This was more exacerbated in the mid-1980s, as an economic recession and rising fuel costs enticed the airlines to increase hard flying time for all employees (Reardon, 1992). Employees under duress do not foster a safe flying environment. If rules are bypassed in favor of financial profit or efficiency, this not only will result in more injuries among aircraft personnel, but it could also result in injuries, illness, or increased hazards for passengers, compromising the safety of the flight itself.

Potential Remedies for Aviation Hazards

1. The Federal Aviation Administration (FAA) should ensure all Aviation Medical Examiners (AME) demonstrate knowledge in assessing basic mental health concerns, and enhance AME training on this topic.
2. The ARC does not recommend mandating formal psychological testing during the pilot hiring process nor as part of routine FAA aviation medical examinations beyond those which already exist.
3. Air carriers should develop effective pilot assistance programs.
4. Air carrier operators should be encouraged to implement mental health education programs for pilots and supervisors that improve awareness and recognition of mental health issues, reduce stigmas, and promote available resources to assist with resolving mental health problems.
5. The FAA should assemble and disseminate information on benchmark pilot support programs, which includes pilot assistance programs, to serve as a resource for air carriers to develop new or improve existing programs.
6. Encourage advocacy for a uniform national policy on mandatory reporting of medical issues that affect public safety.
7. The ARC recommends no changes to the guidance found in FAA Order 8900.1, "Procedures for Opening, Closing, and Locking Flight Deck Doors" concerning two persons on the flightdeck and flightdeck access.
8. The ARC believes existing aircraft and flightdeck door design standards are adequate and no changes are required by the FAA. (FAA, 2015, pp. 2-4)

Figure 2: *Eight new guidelines put forth by the ARC* (DeHoff & Cusick, 2018, pp. 10-11).

The presence of this information calls aviation safety into question since it insinuates that employee safety and health do not appear to be priorities to the airlines. It also indicates that many aircraft personnel are unable to identify threats to their safety acquired on or off the job site (Cahill et al., 2020). Fortunately, air travel safety has maintained the same level of safety since deregulation began, with 0.314 accidents for every 100,000 hours of operation (Reardon, 1992). Even though the accident rate has remained stagnant, there is data to suggest that the margin of safety has decreased. The increase of competition over time has encouraged carriers to prolong maintenance and replacement, and stretch federal minimums (Reardon, 1992).

Additionally, for the accidents that do occur, the well-being of the pilot or crew is often a contributing factor. This, coupled with a pre-existing maintenance issue, may increase the likelihood of an accident. While no method of mental health reporting can be completely foolproof, the presence of this information emphasizes the need for a change, especially following the Germanwings flight 9525 accident (Mulder & de Rooy, 2018).

The U.S could follow the lead of the European Aviation Safety Agency (EASA) to remedy the underreporting of mental health issues among pilots, as they perform “psychological testing of aircrew pre-employment in line flight, access to a psychological support/peer-support resource, and substance abuse testing on a random basis” (Cahill et al., 2020, p. 523). In other words, the EASA requires pilots to be psychologically assessed before joining the airlines, and the pilots must have readily available access to pilot specific peer support programs. The EASA has also placed a greater emphasis on mental health during medical exams, when before the primary object of scrutiny was the physical fitness of the pilot (Vuorio & Bor, 2020). In the past, the FAA has commissioned suggestions from other groups to improve industry safety and wellness. As an example, in 2015, the Pilot Fitness Aviation Rulemaking Committee released eight new guidelines for evaluating pilot mental health, as shown in Figure 2 (DeHoff & Cusick, 2018).

Just Culture

The principles of aviation safety are closely intertwined with just culture. Just culture is rooted in aviation accident mitigation strategies, aiming to improve safety rather than blatantly blaming one party. Just culture does not scrutinize those who honestly report mistakes and strive to promote aviation safety, only those who are reckless and willfully ignore or perpetuate hazards (Mulder & de Rooy, 2018). Incorporating new guidelines regarding mental health and symptom reporting into safety management systems may help identify potential mental health hazards in aviation, especially when using the just culture approach. Establishing pilot focus groups where pilots are open to share their thoughts and opinions on mental health and the best practices to manage it may also help (Mulder & de Rooy, 2018).

Given the stigma around mental health issues, the just culture approach may make pilots feel more inclined to report their symptoms, as they know they will not be punished if they are doing their due diligence to keep aviation safe. To reduce the stigma even further, the FAA or the individual airlines could also focus on providing aid for the flight personnel, rather than revoking a medical certificate or removing them from a job unless it is absolutely necessary (Mulder & de Rooy, 2018). The FAA may have standards in place to prevent incapacitation, and they have put forth new policy in the past, but more radical reform such as the new EASA regulations may help to further advocate for pilot health. The studies have shown that the enforcement of the current FAA regulations is not reflected in industry safety overall.

Conclusion

Based on the research depicted, there is not enough evidence to suggest that flying directly causes significant physical problems among cabin crew and pilots, although it may exacerbate pre-existing risk factors for cancer, cardiovascular disease, or musculoskeletal problems. Deteriorated mental health, on the other hand, appears to have a strong link to flight-related occupations. This is due to the accident risk, the irregularities associated with shift work, and in the case of military personnel, the traumatic events seen in combat scenarios.

Unfortunately, many pilots are reluctant to report mental issues due to the stigma associated with them, or the threat of losing their medical certificate and job. Knowing that mental health problems are unusually prevalent among flight personnel, the U.S military, the airlines, and the FAA should take a more vigilant role in supplying psychological assistance and regulatory protection against having a medical revoked for these employees. Not only do these effects harm the employees, but flight personnel working with less-than-optimal mental states increase the likelihood of crashes and mistakes. In conclusion, the elevated risk of occupational hazard that flight personnel face, the high work-related stress (WRS) levels reported, and the occupational depreciation of mental health are indicative of the need for systemic change in protective safety regulations. This will help make the aviation industry safer through a reduced stigma and just culture centered approach.

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