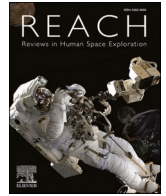


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Mental health implications for aviators from COVID-19

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ABSTRACT

Objective: The authors present aeromedical implications from COVID-19 disruptions on the civil aviation sector, consider mental health impacts on pilots, and discuss possible helpful responses to support pilot mental health. **Methods:** A multiple database review investigated articles from January 2002 to May 2021 on severe commercial aviation disruptions impacting pilot mental health and on pilot mental health coping or treatment. Fifteen papers were identified.

Results: During the COVID-19 pandemic, airline flights were severely reduced. By January 2021, airlines shed thousands of jobs and 24 airlines no longer existed. General population surveys found 13% of individuals had “serious distress” from the pandemic. In two aviation focused surveys, 40–66% of pilots agreed or strongly agreed that their mental health worsened since the COVID-19 pandemic. Compared to past Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) patients, more COVID-19 patients have mental health symptoms in the acute phase of illness; while about 10% of COVID-19 patients appear to have chronic or “long haul” symptoms. Mental Health treatment and coping strategies found helpful to pilots are discussed.

Conclusions: Pilots remain at risk for mental health symptoms and illness due to the COVID-19 pandemic. For those who develop severe distress or mental illness from the effects of the pandemic (or COVID-19 infection), early treatment with psychotherapy and/or approved medications may be warranted. This may decrease the likelihood of persistent physical or cognitive or mental health symptoms that would delay a return to flying status.

1. Introduction

The COVID-19 coronavirus pandemic has been a globally disruptive force unlike any event that the living population, with very few exceptions (those over 100 years of age) have ever experienced. One hundred ninety-two countries had reported over 172.3 million cases by March 2021, with only 14 countries in the entire world reporting no cases. [1] It has required international government interventions to limit travel due to the pandemic that significantly and negatively impacted the commercial aviation industry. [2] The devastation in loss of lives,

personal health, national economic productivity, governmental unity, personal financial resources, and social connection have been unmeasurable. The death rates defy easy socioeconomic classification of countries, with the top five rates per 100,000 individuals occurring in: Peru, Brazil, Poland, Columbia, the United States. [1] It has socially isolated (or quarantined) millions of people, depriving them of psychological and social comfort at a time of tremendous emotional stress.

The COVID-19 pandemic has created a tremendous negative impact on the aviation industry, causing a severe reduction in flying passengers, a grounding of aircraft and furloughs of professional pilots. [3] While it

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is suspected such work disruptions would negatively affect pilot mental health, there are very few studies examining the psychological impact of workplace (or disaster related) disruptions events. Girodo identified 25 % of pilots who were “psychologically at risk” due to an ongoing airline labor dispute, suggesting that work disruption will negatively impact pilots’ mental health. [4] Little, et al. found that pilots in an airline with corporate instability, compared to those in a stable airline organization, reported significantly more stress and depression symptoms. [5].

Because of the duration and magnitude of the current disruption of commercial aviation by COVID-19, the authors conducted a literature review addressing the following questions: (a) did the COVID-19 disruption of the civil aviation sector create mental health problems for professional pilots and (b) were any mental health responses identified as beneficial to pilots during the time of several commercial aviation downturn events (2002 to May 2021)? In addition to discussing these two questions, the paper will also summarize current bio-psychosocial information on COVID-19 that may impact an aviator’s mental health status. Information on mental health and cognitive concerns from past coronavirus outbreaks [Severe Acute Respiratory Syndrome (SARS) in 2003, Avian Influenza (H5N1) in 2005–2007, Middle East Respiratory Syndrome (MERS) in 2012–2015] is provided. Responses that appear to be of benefit to pilots’ mental health are identified.

2. Method

A multiple database (EBSCO, OVID [PsychInfo, MEDLINE], PubMed) literature search was performed with the inclusive dates of January 1, 2020 to May 31, 2021. Included articles were limited to: (a) peer reviewed, (b) available in full-text in English, (c) any pilot and (d) mental health. The first search string used “pilots or air pilots AND mental health AND aerospace medicine AND therapeutics.” The second search string added “AND covid.” In combination, this process identified sixty-nine articles. Iterative hand searching on topical references and articles from the authors’ knowledge of the literature added eight articles to the results. All articles were reviewed by two authors (CF and REK) independently to identify the final 15 articles that were pertinent for final inclusion. The process is noted in Fig. 1. Additional searches in the grey literature (<https://www.google.com>) were conducted during

March to May 2021 targeted on COVID-19, the 2003 Severe Acute Respiratory Syndrome (SARS) outbreak, the 2005–2007 Avian Influenza (H5N1) outbreak, the 2012–2015 Middle East Respiratory Syndrome (MERS) outbreak and September 11, 2001 attacks impact on commercial aviation. The searches started with “event (SARS or Avian Influenza or MERS or September 11, 2001 attacks) impact on commercial aviation.” Seven articles were included (references 21 to 27) in this paper that provide additional background information for comparison to the impact from the COVID-19 pandemic.

3. Results

Table 1 presents the results of the literature review, specifically identifying the 15 papers and categorizing them based upon those specifically related to the COVID-19 pandemic and those related to pilot coping, treatment, and mental health. The primary topic of each study, the method of gathering information, the sample size, study population location and the relevant findings are listed. Forty to sixty percent (40–60 %) of pilots reported that the COVID-19 pandemic had worsened their mental health; and experts feared that the pandemic could increase the risk for pilot suicide. [6–9]. In one survey during the COVID-19 pandemic, 10 % of responding professional pilots reported suicidal thoughts in the prior two weeks. [6] None of the identified coping or treatment strategies were specifically linked to the coronavirus pandemic. Of pilots who reported using coping strategies to manage stress, exercise, active rest, and diet management were the top choices. [10,11] Successful treatment with SSRI medication and/or evidence-based therapies assisted aviators to return to flying status. [12,13] Pilots with higher capabilities in mindfulness, cognitive flexibility (employing cognitive behavioral therapy principles), and proactive coping (strengthening cognitive and social supports) seemed to have lower levels of stress or stress-related mental health symptoms. [14–17] Pilot peer support programs were viewed positively as a means to deliver pilot emotional support. [18–20].

4. Discussion

This review focused on organizing the available information that could provide information on the impact of the COVID-19 pandemic on aviator mental health and whether any mental health treatment strategies were identified as helpful. Because the COVID-19 pandemic has created such a powerful negative impact on commercial aviation employment, these results are consistent with what would be expected: about half of surveyed aviators state their mental health has worsened due to the pandemic. Workplace stressors that have been previously identified as negative for professional pilot mental health include airline or company instability: a current pandemic outcome. No treatment strategies were identified that were specific to the COVID-19. Aviators in distress may need treatment to safely return to fly, yet these treatments may be limited (or prohibited) due to pandemic restrictions on face-to-face patient care. Therefore, professional aviators have an additional pandemic stressor: how to manage regulatory requirements to maintain flying status. Further discussion sections below will amplify what is known from the current COVID-19 pandemic: population mental health stressors from this pandemic (with insights from prior disaster events on commercial aviation), mental health outcomes from COVID-19 infection (with insights from prior coronavirus pandemics), pilot mental health coping and treatment strategies for clinicians (with insights from the authors’ experience and current COVID-19 literature), and specific regulatory changes that have created flexibility for pilots to maintain their flying status.

4.1. Disaster events and negative impact on commercial aviation

To attempt some comparisons to our current experiences, it is useful to consider four other catastrophic events that impacted commercial

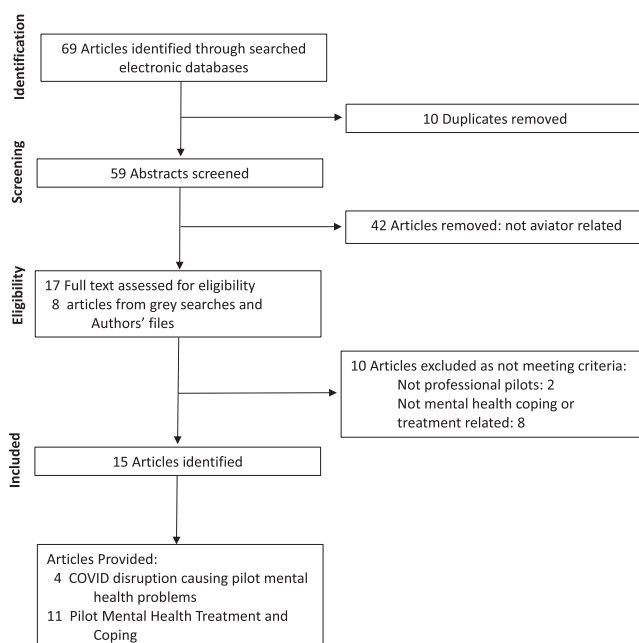


Fig. 1. Flow-chart depicting the search strategy employed to find the articles included in this review.

Table 1
Main Findings and Method of Information Gathering by Major Theme.

Author	Topic	Sample size, type	Method	Findings
COVID and Aviator Mental Health				
Alaminos-Torres et al., 2021 ⁸	COVID Impact on Professional Pilots	342 professional pilots, Spain	GHQ-12	43 % of pilots were near the cut-off score for psychopathology, suggesting “at risk of psychological distress” from COVID
Cahill et al., 2021 ⁶	COVID Impact on Aviation Workers	2050 aviation workers, 720 professional pilots, Multiple Countries	Multidimensional information survey, and PHQ-9, GAD-7	66.8 % of pilots reported worsened mental health since COVID and 10 % of pilots reported suicidal thoughts in the past 2 weeks
Charman & Mann, 2021 ⁷	COVID Impact on Professional Pilots	2598 professional pilots, Multiple Countries	Multidimensional information survey	40 % of pilots reported worsened mental health since COVID, and 35 % were considering changing their career
Vuorio & Bor, 2020 ⁹	COVID Stress and Pilot Suicide Risk	Aerospace Medicine & Psychology Experts	Expert Opinion Recommendations	COVID threatens Pilot mental health by economic downturn and by infection and access to psychological support is recommended
Pilot Coping, Treatment and Mental Health				
Cahill et al., 2021 ¹⁰	Work Related Stress and Coping Methods	1059 professional pilots, Multiple Countries	Multidimensional information survey, PHQ-9, Oldenburg Burnout (and modified),	83 % of 736 pilots (responding to his portion of the survey) identified Work Related Stress impacted their performance; 59 % of 783 pilots (responding to this portion of the survey) used Coping Strategies: exercise 92 %, focusing on sleep/relaxation 88 %, focusing on diet 84 %
Kelley et al., 2020 ¹³	SSRI use Supports Aviator Mental Health	114 US Army pilots	Review of Aeromedical Outcomes Database	63 aviators maintained flying status with SSRI treatment
Li et al., 2020 ¹⁵	Mindfulness Improves Pilots' Anxiety	319 professional pilots, China	Mindful Attention Awareness Scale, GAD-7, Maslach Burnout Inventory-General Survey	Pilots with higher mindfulness scores tended to have lower burnout ($p < .001$) and anxiety scores ($p < .001$)
Pinsky et al., 2020 ¹⁹	Expert Opinions on Preventing Pilot Suicide	Aerospace Medicine & Psychiatry Experts	Expert Opinion Recommendations	Airline Pilot Peer Support is highlighted as one successful example of pilots supporting pilots in distress
Santilhano et al., 2019 ¹⁸	Pilot Peer Support Improves Well-Being	6 professional pilots, South Africa	Semi-structured interview, Expert Opinion Recommendations	Peer Support was viewed as a positive contribution to the emotional well-being of pilots
Sung et al., 2019 ¹⁷	Cognitive Flexibility Reduces Stress and Psychological Symptoms	192 South Korean Air Force pilots	Multidimensional information survey, Cognitive Flexibility Inventory, Hopkins Symptom Checklist-90-R, Fighter Pilot Work Stress Scale	A pilot's Cognitive Flexibility significantly reduced the presence of psychological symptoms from elevated stress ($p < .05$); cognitive flexibility follows cognitive behavioral therapy principles
Mulder et al., 2018 ²⁰	Pilot Peer Support	Literature Search on peer-support programs	Summary of Search Findings	Peer-Support programs are appreciated by those involved, but a protective effect on pilot mental health has not been established
Guo et al., 2017 ¹⁴	Proactive Coping Helps Pilot Mental Health	319 professional pilots, China	Trait Meta-Mood Scale, Proactive Coping Scale, PHQ-9, GAD-7	A significant relationship was found that pilots with proactive coping skills had reduced depression scores ($p < .001$), and anxiety scores ($p < .001$); proactive coping is defined as seeking social support and resources to prevent or modify a potentially stressful situation before it actually arises
Heaton & Wood, 2015 ¹²	Post Traumatic Stress Disorder Outcomes in Pilots	32 (of which 5 are pilots) US Air Force aircrew members	PCL-5, PHQ-9, MAB-II, MicroCog, MMPI-2, NEOPI-3	90 % of aircrew members (pilot specific % is not offered) with PTSD returned to flying status after successful PTSD treatment
Feijó et al., 2012 ¹¹	Coping and Pilot Mental Health	807 professional pilots, Brazil	Multidimensional information survey, and Self Reporting Questionnaire-20 (to assess common mental disorders)	Regular physical exercise afforded a possible protective effect against suspected cases of common mental disorders
Widyahening, 2007 ¹⁶	Pilot Occupational Stress Increases Emotional Disturbances	109 professional pilots, Indonesia	Multidimensional information survey, and Hopkins Symptom Checklist-90	39 % of pilots had a score that suggested mental-emotional disturbance (distress); pilots with high or very high levels of work stressors had 4.6 times greater risk; help by improving social support and reducing pilot work stressors

aviation and pilots in this century: the September 11, 2001 attack, the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, the Avian Influenza (H5N1) outbreak in 2005–2007, and the Middle East Respiratory Syndrome (MERS) outbreak in 2011–2015. There was appropriate and extensive concern about these disasters, which created psychological trauma and economic damage for millions of people. For instance, after the September 11, 2001 attacks; it took three years to regain the August 2001 flying demand in the United States. [21] In 2012, US airline employment was still 20 % below July 2001 levels. [21] The SARS outbreak in 2003 created 8028 cases and 774 deaths in 29 countries. [22] The H5N1 outbreak in 2005–2007 triggered 271 cases and 165 deaths in 13 countries. [23] During SARS there were three million lost tourism jobs in four South Asia countries, while for H5N1 a drop of 12 million passenger arrivals in eleven countries was noted. [24] International tourism arrivals dropped by 1.2 % worldwide due to the SARS outbreak, at one point reducing worldwide airline flights by 3 %. [25,26] The MERS outbreak in 2012–2015 caused 1321 cases, 455

deaths and 13,500 South Koreans to be quarantined. [27].

Comparing these events to recent information for the COVID-19 pandemic, there were 2.5 million deaths worldwide from January 2020 to March 2021. [28] As one healthcare worker described, “I’ve done more CPR and seen more people die in the last two weeks that I have in my entire career combined.” [29] In response to the global devastation in health and economies, there was an unprecedented demand on the healthcare systems and a moratorium on air travel. By 2020, there was a 74 % decrease of passengers flying internationally and 50 % flying nationally: with a 38 to 66 % drop in flights. [30] Airlines were flying fewer people than they had since the 1950’s. [2] While several major airlines declared bankruptcy after the September 11, 2001 terrorist attack, they were able to re-organize. In contrast, as of January 2021, 24 airlines (including major carriers) no longer existed. [3] In the face of these overwhelming negatives, pilots not only shared the general population’s distress from the pandemic, but their lives were also severely and directly impacted by the loss of aviation jobs.

4.2. Population (including Pilots) negative impacts from COVID-19 pandemic

4.2.1. Psychological impacts

Individuals infected by COVID-19 experience biological impacts that create psychiatric symptoms. (see Section 6) However, even individuals who do not become ill with COVID-19 are psychologically changed by the effects of the pandemic. At nearly every turn of positive updates, new negative twists seemed to erupt. Effective vaccines were developed incredibly rapidly and afforded some protection from coronavirus infection. However, variants with higher levels of infectivity arose, against which some vaccines were less effective. Despite high vaccine efficacy, overall, US population acceptance of vaccine use is based upon personal risk assessment, the FDA “experimental emergency use” designation and political factors. For instance, the US Centers for Disease Control (CDC) provided guidelines for the cruise ship industry to restart retail sales that are based upon admitting a minimum of 95 % vaccinated customers and having crews at least 98 % vaccinated. However, several states where cruise ships port, such as Florida; have made it illegal to ask potential passengers about their vaccination status. [31] In the US, even with national public health guidance, the pathway to defeat the coronavirus pandemic is unclear.

The situation described above creates a sense of “loss of control,” which for aviators is particularly vexing. Aviators have a strong psychological foundation in their “sense of self” through fulfilling a purpose and feeling “in control” to create optimal outcomes. Research with military pilots, many of whom will transition to commercial aviation, reveals that they are conscientious: which is comprised of the facets of competence, order, dutifulness, achievement-striving, self-discipline and deliberation, with the facet of achievement-striving being most prominent. [32] How can they achieve good outcomes when presented with conflicting approaches on how to control spread of the virus? Should individuals travel from state to state or internationally, or will this spread disease? What measures would be effective in preventing the spread of illness?

Thoughtful individuals (a group that likely includes the majority of aviators) might believe there is no way to plan effectively for the future, because the endpoint of the pandemic is not “knowable.” Further, suffering social isolation and limited contact with loved ones might be acceptable – if it actually defeated the pandemic. But, what good is this lack of travel and isolation if it doesn’t end the pandemic? Suffering without a purpose for a positive outcome becomes self-defeating and can induce a psychological state of “learned helplessness.” [33] In this state of mind, the individual comes to believe “no matter what action I take, I cannot change the bad outcome,” leading to apathy and depression.

Yet, aviators are being affected by the pandemic’s devastating effects on their occupation and income. As the outbreak spread, countries quickly restricted travel to keep ill individuals from bringing COVID-19 to new locations. However, planes continued to fly passengers. [30] Would pilots consider their work to be facilitating the arrival of life-saving capabilities (healthcare workers and medical supplies) or would aviators fear that their work was facilitating the spread of a deadly disease around the world? The moral and ethical weight of those questions brings a heavy psychological burden. Widyahening’s survey of airline pilots concluded that pilots with high or very-high levels of work stressors had 4.6 times the risk for mental-emotional disturbances. [16] Separately, for those not employed during the pandemic, about 14 % of 2050 aviation workers felt a loss of confidence in their skills after the prolonged period out of work. [6] Sixty-six (66.8 %) percent of all surveyed pilots reported that the pandemic had negatively affected their mental health, with 10 % having had passive suicidal thoughts in the two weeks prior to answering the survey. [6] In a separate survey of 2598 professional pilots, 47 % were unemployed or furloughed due to the pandemic and 35 % reported they were considering changing their career. [7].

The psychological load from the pandemic would have been easier to

bear with the ability to move freely and meet in-person with family and friends. However, when individuals were ill or grieving; social isolation prevented obtaining the comfort of family and friends. Social support is thought to be an important factor that enhances resilience in times of disaster. [34] Although grateful for the ability to connect through video, many in isolation felt this to be an ineffective response to the needs of those whom they love. The loss of ‘true’ eye-contact and human-touch in video chats impoverished these relationships. [35] Grief and emotional pain were more difficult to assuage in isolation.

4.2.2. Social impacts

As social isolation and quarantines were implemented, national economies were shattered. By November 2020 in the US, 22 million workers had lost their jobs and there were 10 million fewer jobs available. Nearly 4 million workers had been out of work at least 27 weeks, causing tremendous financial hardship on families. For those still working full-time, 33 % had taken a pay-cut. Workers affected by long term unemployment (27 + weeks unable to work) are more susceptible to symptoms of depression, anxiety and low self-esteem. [36–38] Families feared the costs (for loss of health and finances) of a member becoming ill with COVID-19 by continuing to work. [39] Social isolation and quarantine requirements amplified emotional turmoil by interfering with coping strategies, increasing symptoms of depression, anxiety and stress. [40] A survey of stress found 13 % of individuals in “serious distress” in July 2020, compared to only 3.9 % with that level of severity in 2018. [41].

The contraction of the travel industry drastically reduced pilot employment. In a survey of 2050 aviation professionals 50.9% have lost their jobs (and 38 % of the total respondents were professional pilots). [6] This derailed income for already-hired pilots, and for those carrying loans for training and expecting to join the workforce. [30] Families could lose their entire income with the sole aviator worker unemployed. Alternatively, a partner who was still working could be “overloaded” by increased (and possibly unsafe) work demands. Children were unable to attend school, yet family support was more difficult to achieve due to isolation requirements. [42] Moreover, each COVID-19 death affected up to nine family members; leaving many families without extended emotional and financial back-up assistance. [40] The most common stressors in a surveyed population in July 2020 included: loss of employment or work overload (65 %), financial fears of loss of medical insurance or inability to cover costs for rent and food (60.6 %), and fear of contracting COVID-19 or new variants (65.9 %). [41].

The weight of these burdens from job loss, financial setbacks and new childcare demands overwhelmed many individuals’ coping skills. These burdens created amplified symptoms of stress (29.6 %), anxiety (31.9 %), and depression (33.7 %) in an international population. [43] In a survey of US adults, one or more adverse mental health conditions were present in 40.9 %; and 10.7 % had seriously considered suicide in the past 30 days. [40] One survey on couples found the social isolation demands due to COVID-19 created significantly higher parental burnout scores for mothers, but significantly higher marital strain scores for fathers. [44] Aviation-worker families would be expected to have similar stressors. As noted above, 40–66 % of professional aviators reported their mental health had worsened during the pandemic. [6–8].

4.3. Population (and Pilot) negative impacts from COVID-19 infection

COVID-19 viremia generates inflammation and cell death due to acute viral replication. [45] Direct effects on the brain may not be the only cause of biological symptoms. COVID-19 symptoms may also be related to a secondary hyperinflammatory response. [45] The follow-on process could cause neuronal damage by an inflammatory response causing vascular leakage, clotting and possibly overwhelming cytokine release. [46,47] Consistent with this type of injury, brain autopsies from COVID-19 patients showed effects from systemic hypoxia, endothelial dysfunction, and microthrombi. [48] This section provides an overview

of the neurological, psychological and social changes related to COVID-19.

4.3.1. Neurological impact of COVID-19 infection

COVID-19 is caused by a coronavirus that crosses the blood brain barrier, which appears to create brain injury by two processes. Preliminary evidence suggests direct effects of viral invasion of astrocytes, leading to neuronal injury and death. [49] On brain imaging, clots from vascular leakage are seen as dark areas on MRI brain scans, while areas of immune reaction causing cellular damage are visualized as brighter areas. [46] Cerebrovascular events occur in up to 62 % of patients hospitalized with acute COVID-19 infection. [50] Patients with pre-existing psychiatric diagnoses are 65 % more likely to become infected with the virus. [51] This may be due to poorer health status pre-infection, poorer living situations that reduce the ability to practice safer public health strategies, inferior knowledge of how to avoid infection or a brain biological susceptibility. [51] Hospitalized COVID-19 patients with a history of mood disorder appear to be at greater risk of death. [52].

These biological effects create symptoms of encephalopathy, delirium, psychosis, anxiety, and depression. In one study of 125 hospitalized patients, 39 (31 %) had an altered mental status (AMS) in the acute illness phase, which included: 16 (13 %) had encephalopathy, 23 (18 %) had psychiatric [of these 10 (8 % of total) had new-onset psychosis symptoms, six (5 % of total) had neurocognitive changes and seven (6 % of total) had other mental disorders]. [50] A separate study of 58 intensive care unit patients with COVID-19 found nearly 70 % experienced agitation or confusion. [53] In older patients, a 2–3 times higher risk for a 1st diagnosis of dementia was noted in a large cohort population. [51] Of two studies on patients admitted with COVID-19, 15.4 % died in the hospital, while a cumulative 29.2 % did not survive 60 days after discharge. [52,54] The psychological and social effects of this death rate has been devastating for families and healthcare providers. As one healthcare worker described, “It can be emotionally exhausting to give so much to your patients and they’re still dying at such a high rate.” [29].

4.3.2. Cognitive concerns for airmen from COVID-19 infection

Among the concerns for aviators who have been infected with COVID-19, is the potential for lingering memory or cognitive problems. As noted earlier, about one third of past patients with coronavirus infections (SARS, MERS) had lingering cognitive complaints. [55] Currently, COVID-19 patients whose symptoms have continued beyond two months may have continued cognitive problems, self-described by many as “brain fog.” [56] In one study of 61 COVID-19 patients who participated in a neuropsychological evaluation between 21 and 120 days after diagnosis, abnormal performance was found in 38 % on logical memory, 34 % on TRAILS A and 56 % on TRAILS B testing. [49].

4.3.3. Illness data from past coronavirus pandemics

Data from two past coronavirus pandemics might offer possible insights into the future course of the COVID-19 pandemic. Are there similar percentages of symptoms? What may be expected when considering recovery of infected individuals? Up to six weeks post infection, more than 10 % of SARS or MERS patients had significant mental health symptoms of depression, anxiety, and insomnia; as well as cognitive symptoms of memory loss. [55] Current data from COVID-19 patients suggest even higher rates of early mental health symptoms. [57,58] Long term recovery (with up to 12 years of follow up) showed an ongoing burden with over 30 % of SARS and MERS patients having developed mental health symptoms. [55] In data from COVID-19 patients who are more than two months post-infection, 5.8 % to 56 % have at least one mental health symptom from their illness. [49,51,59,60] These symptoms include: fatigue, myalgias, shortness of breath, and cognitive changes (“brain fog”). The presence and intensity of “long hauler” symptoms have not been found to be correlated with severity of

the patient’s illness. [56] See Table 2.

4.4. Response concepts for airmen mental health impacts from COVID-19

4.4.1. Regulatory relief for airmen

As the COVID-19 pandemic spread, the standard model of “in-person” visits for medical treatment was overturned. Almost immediately, nearly all US health (and mental health) practitioners shifted to providing virtual/telehealth visits. [61] In the US, many practices remained temporarily closed as medical boards decided how to safely allow patient care. This created delays in renewing time-limited airmen medical certifications, causing regulatory concerns and possibly preventing pilots and air traffic control specialist (ATCSs) from working. On-boarding of ATCSs, who are required to complete a psychological screen administered in a Federal Aviation Administration (FAA) facility as part of their pre-employment medical assessment, ground to a halt as these individuals are not yet considered employees and “visitors” were barred from FAA facilities. The FAA responded to the certification needs of incumbent pilots by creating a Special Federal Aviation Regulation that permitted delays for renewing required certification examinations

Table 2
Data Regarding Patients’ Mental Health Symptoms after COVID-19, SARS or MERS Infection.

Topic	COVID-19, up to 6 weeks	SARS, MERS, up to 6 weeks	COVID-19, 2 months or longer	SARS, MERS; 2 months to 12 years	Comments ^{c,d}
Depressed mood	31 % ⁵⁷	32.6 % ⁵⁵	18 % ⁶⁰ to 20 % ⁴⁹	10.5 % ⁵⁵	⁴⁹ N = 61, Brazil. ⁵⁵ N = from multiple studies. ⁵⁷ N = 402, Italy. ⁶⁰ N = 478, France
Anxiety	42 % ⁵⁷	35.7 % ⁵⁵	23 % ⁶⁰ to 28 % ⁴⁹	12.3 % ⁵⁵	
Memory Loss ^b		34.1 % ⁵⁵	21 % ⁶⁰ to 38 % ⁴⁹	18.9 % ⁵⁵	
Executive Dysfunction ^b			34 % ⁴⁹ to 56 % ⁴⁹		
Insomnia	40 % ⁵⁷	41.9 % ⁵⁵	30.8 % ⁵⁹	12.1 % ⁵⁵	⁵⁹ N = 120, p = 0.535, France.
Any Mental Health Diagnosis ^b	55 % ⁵⁷		5.8 % ⁵¹ to 18.1 % ⁵¹	14.8 % ⁵⁵ to 32.2 % ⁵⁵	⁵¹ N = 62, 354, p < 0.0001, United Kingdom.
Hospitalized, any Mental Health symptom (including fatigue) ^b	53.1 % ⁵⁸		31 % ⁶⁰ to 55 % ⁵⁹		⁵⁹ N = 120, p = 0.891, France. ⁵⁸ N = 143, Italy.
Long Hauler’s symptoms ^a			10 % ⁵⁶		⁵⁶ N = ongoing population study, United Kingdom.

Notes:
^a symptoms include fatigue, myalgias, SOB, ‘brain fog’ [poor memory or concentration].
^b this is not including confusion caused by delirium.
^c statistical significance is provided when available.
^d sample size and population location are included when available.

for most airmen through a maximum date of April 30, 2021. [62] This authorized delay allowed currently certified airmen to continue their duties on an expired certificate. [63] The European Union Aviation Safety Agency (EASA) approved similar extensions for airmen medical certifications. [64] Most airmen certificates were extended to a maximum date of July 31, 2021. [65].

The FAA also approved flexibility to other regulatory requirements. Each air traffic control facility established separate teams of controllers that would stay together throughout the duty week. This limited the possibility of cross-exposure to COVID-19. [66] In addition, the FAA allowed medical providers to use telehealth appointments (except for drug testing, physical examinations and nearly-all first mental health appointments) to meet some airmen mental health evaluation requirements. Based upon individual provider's state medical board guidance for restarting in-person visits, the FAA has continued to allow some medical evaluations to be conducted by telehealth; when not believed to compromise effective airspace safety standards. [67,68].

For individuals (and airmen) in treatment for addictions, the pandemic derailed a long-established system of care founded on in-person visits. In-person human interactions were considered essential to addiction treatment success. [69] Experts voiced concerns that lower mutual support (e.g., Alcoholics Anonymous) connections would lead to higher relapse rates. [70] Yet, mutual support group meetings and follow up treatment visits could only be completed virtually. Initial data on this new approach to addiction treatment are generally favorable, with patients finding telehealth video visits more convenient, but less emotionally connected. [71] There were fewer drug tests performed; and different strategies for testing were created. 'Drive through' urine testing locations were started and 'at home' saliva tests were relied upon. [72] Fewer new patients were started on medication-assisted therapy (MAT). However, for those patients already using MAT, there was no significant decrease in filled prescriptions or clinician visits. [73] Take-home methadone treatment led to increased treatment engagement and lower hospitalization rates. [74] The FAA accepted these constraints for airmen participating in its substance treatment program. Still, the FAA did not relax enforcement of legally required random drug and alcohol testing.

4.4.2. Coping or treatment concepts that may benefit airmen with mental health concerns

An aviator's psychological strengths are thought to be connected to an ability: to control variables for a positive outcome and to fulfill a sense of purpose, which are driven by conscientiousness. [32] The COVID-19 pandemic has attacked these areas that provide a psychological foundation for aviators. In a 2020 survey of 2598 pilots, 40 % agreed that their mental health had been negatively affected due to: loss of employment, loss of income, job insecurity due to the pandemic, loss of control due to impact of government decisions on their jobs and 35 % were considering changing their career. [7] While there are no specific data available yet about treatment of aviators during the COVID-19 pandemic, we can review data from treatment strategies used by healthcare workers (who share with aviators, a similar psychological foundation for self-esteem). In 600 clinicians in New York City, which was hard-hit by pandemic illness and deaths; treatment options were made available by their hospital organizations. Across treatment options, 59 % used physical exercise, 26 % used psychotherapy, 23 % used spiritual practices, 23 % used self-meditation, and 16 % used social support to help maintain their well-being. [75] Professional pilots chose exercise as a top coping strategy (92 %) for stress and in a separate study exercise was likely to be protective in reducing the risk for developing common mental conditions. [10,11].

Meditation is aligned with the concept of "mentalization," a therapeutic approach that encourages patients (among several treatment tasks) to "stay in the present" more than "looking to the future." [76] Li found mindfulness (a mentalization technique) reduced commercial pilot anxiety. [15] During the pandemic, where there is more confusion

about the future (and how to achieve an optimal outcome); this shift toward a focus on the "present" could be advantageous. Working to achieve "near time" goals reassures individuals that although the future may be less 'knowable', their efforts can still create a positive impact. [77] This approach of focusing on "the present needs" is also used in psychological first aid strategies during a disaster response. Tactics encourage establishing basic health needs and connecting to social support. These strategies may also be useful in assisting suffering airmen, as it would highlight that their efforts (that are within their control) could help to reduce their distress.

Based upon these limited data regarding treatment, airmen who have developed psychiatric symptoms from COVID-19 infection or pandemic stress may benefit from "problem-solving" and "present-focused" treatments. As aviators are more "action oriented" rather than "talk oriented," these concepts could reduce negative outcomes from their elevated stress levels. Guo, et al. joined these two ideas in showing how professional pilots who used proactive coping techniques had lower levels of depression scores and anxiety scores. [14] Proactive coping is defined as seeking social support and developing other coping resources prior to a potentially stressful event.

Identifying grief as an appropriate response to multiple losses, rather than allowing anger to become a unifying emotion, could also be valuable. Reducing anger, reduces the aviator's risk for increased interpersonal friction within the aviator's social support network (which is already strained by isolation). This type of emotional awareness fits with Sung's study of military pilots, where identifying negative thoughts could lead to counteracting them with cognitive behavioral therapy techniques. Pilots with greater "cognitive flexibility" had lower levels of psychological symptoms (even when experiencing elevated stress levels). [17].

Limited data suggest that the pandemic has generated greater emotional distress, leading to an increased consumption of alcohol in 32 % of regular drinkers and relapse to alcohol use in 19 % of ex-drinkers. [78] Therefore, airmen who are "at risk" for addiction warrant close attention to these symptoms during evaluation and treatment. Pragmatic coping strategies would include: limiting substance use, getting exercise, attaining sufficient sleep, and caring for already known health conditions. [10] Treatment of anxiety, depression, post traumatic stress disorder and stress disorders using psychotherapy (and when needed SSRI approved mental health medications) has successfully returned professional aviators to flying status. These treatments should be considered when coping strategies are not reducing a pilot's distress. [12,13] For professional pilots who are in distress, a "first step" that is widely regarded as helpful is reaching out to a pilot peer support network. [18–20] These peer pilot volunteers are trained to provide emotional support and deliver helpful guidance on how the pilot may access additional counseling or mental health treatment.

4.4.3. Coping or treatment concepts that may benefit airmen with cognitive concerns

Cognitive symptoms (concentration or memory impairment) measured in 323 healthcare workers with mild COVID-19 illness, did show a trend of symptom improvement between follow-up months two and eight. [79] Unlike the initial response to a traumatic brain injury, where cognitive rest is essential in restoring health, some researchers are focusing on active brain retraining strategies for affected COVID-19 patients. [80] They are employing mental activities that encourage use of memory, attention and concentration capabilities.

As of June 2021, the FAA and EASA have not established a requirement for cognitive assessment in airmen who have recovered from COVID-19. However, airmen with cognitive concerns should discuss this and plan further evaluation with their aeromedical physician. Because their aviation duties rely on their use of memory, attention and concentration, airmen with cognitive concerns should consult their physician. Effectively managing any current illness, resuming exercise, when possible; obtaining sufficient sleep and avoiding the use of alcohol

and illicit substances are all helpful initial steps to address the problem. [81] Caution is advised for the use of nootropic supplements that are advertised to enhance cognition. [82] These supplements are not regulated, and their ingredients may have unpredictable effects when combined with a post COVID-19 infection brain state. [83] Proactive airman might consider having their cognitive abilities baselined to provide a point of comparison for future assessments.

4.5. Planning forward

At the time of this paper's writing, major airlines are expecting a return to higher passenger utilization by the end of 2021. However, the COVID-19 pandemic has shown an unpredictable trajectory toward quiescence. A return to social isolation and severe travel restrictions may re-occur in the future. The one apparent constant of the pandemic is limited public confidence in scientific recommendations, national health guidelines, and vaccines. Therefore, personal risk assessment (along with the willingness to overcome the friction caused by public health mandates at destination locations and upon returning home) will determine how many individuals will resume national and international travel. As of June 2021 in the US, it appears that only about 50 % of the population have accepted full vaccinations. Incomplete national population immunity could require quarantines for future travelers to limit the risk of spreading COVID-19 variants. While airlines may be willing to fly more planes, a return to 2019-level travel demand may still be delayed into the distant future.

These factors suggest an ongoing disruption of the aviation and tourism industry, with consequent ongoing loss of employment and income for aviation-related workers. By the end of Summer 2021, the FAA and EASA expect to return to routine regulatory examination schedules and the requirement of in-person provider visits. Yet, some flexibility with telehealth visits could become acceptable to aeromedical regulatory officials. This option will be constrained in the US, if state medical boards re-apply restrictions on assessing and/or treating out-of-state patients. Virtual participation by airmen in addiction mutual support and mental health monitoring may continue to be allowed, in limited situations, as well. Since there is no clear path to ending the pandemic quickly, national aviation regulatory organizations may show continued agility in finding ways to successfully implement airmen aeromedical requirements, into the near future.

4.6. Limitations

This review was thorough but limited in the number of papers providing specific data on aviator mental health impact due to the COVID-19 pandemic or aviator mental health treatment found helpful during the COVID-19 pandemic. Therefore, the authors added material regarding aviator mental health treatment and coping strategies from the time period since the September 11, 2001 attacks (which also covered the time of several additional international downturns of commercial aviation). Pilot mental health impact of work stress was also added from the author's knowledge of the literature during this 2002-to-2021-time frame. The discussion was expanded to identify regulatory factors that were implemented to assist professional aviators during the pandemic. It is possible that the search strategies did not capture all papers; and only papers printed in English were included in the review.

4.7. Future research

The areas for future research are broad. Because of the limited insight into professional pilot mental health, future research that capitalizes on anonymous surveys of this population is needed. Using validated questionnaires that detect mental health symptoms would be optimal. In conjunction with these symptom inventories, workplace and social stressor risk factors could be quantified; as well as coping and/or treatment strategies that have been utilized. Pilot mental health is vital

to the safety of commercial aviation and finding way to better understand and support them is warranted.

5. Conclusion

While airmen and aeromedical regulatory agencies have experienced prior pandemics in this century, none had fully prepared them for the disruptions caused by COVID-19. This coronavirus has devastated personal health and well-being (through infection, social isolation, financial loss), the travel industry, as well as national and international economies. Pilots and airline workers have been hard-hit by the pandemic due to the consequent contraction of the travel industry. By 2020, there was a 74 % decrease of passengers flying internationally and 50 % flying nationally. The stressors created by the pandemic have led to significant mental health symptoms in up to 40 % of general population individuals. Although data is limited regarding the pandemic's impact on professional pilot mental health, sixty-six (66.8 %) percent of all surveyed pilots reported that the pandemic had negatively affected their mental health and 47 % were unemployed or furloughed due to the pandemic.

All aviators experiencing mental health symptoms from the pandemic are encouraged to seek early assistance. Pragmatic (including exercise) and proactive coping strategies appear useful for pilot stress reduction. An aviator's usual coping approach of 'attempting to control variables for better outcome' may create more distress due to the ongoing confusion about how the pandemic will end. For pilots with greater distress, treatment with cognitive, evidenced-based psychotherapy and approved SSRI medications are likely to be helpful. In preparing for future pandemics, it appears that the "unexpected" and "unknowns" of the illness will require flexible regulatory engagement for the aeromedical certification of airmen. Future research should continue to develop greater insights into the level of professional pilot mental health distress, affiliated work and social stressors and therapeutic strategies that are most useful. This will provide benefits for aviator mental health during this COVID-19 and for future pandemics.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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