Sleep Quality and Mental Health Consequences of COVID-19 Pandemic in the Aviation Community in Greece

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Objective: The aim of this study was to assess the mental health and sleep quality of aviation workers in Greece during the pandemic. **Methods:** A cross-sectional study of aviation workers in Greece was conducted. **Results:** Sleep disturbances were observed in 25.4% of our 548 participants, whereas 8.2% and 5.8% reported at least mild depressive and anxiety symptoms, respectively. The impact of the pandemic on their mental health was their primary concern, which increased for many active pilots according to their workload. Those infected mainly faced daily tiredness and fatigue. Smoking habits and high body mass index were a predisposition for more physical symptoms. Cabin crew and women generally yielded worse scores than the other groups. **Conclusion:** Fear of infection could explain mental health issues, whereas physical symptoms of those infected could be attributed to long-COVID (coronavirus disease) syndrome. Flight attendants' lower ratings may be due to more occupational exposure.

Keywords: cabin crew, Epworth questionnaire, fatigue, pilots, Pittsburgh Sleep Quality Index

Coronaviruses affect most of the body's organs, with the respiratory system being the most severely compromised. Postinfection symptoms concerning mental well-being include persistent fatigue,[1] anxiety, depression,[2] and insomnia,[3] and beyond the clinical setting, the pandemic has also induced adverse health effects.[4] Quarantine has emerged as a risk factor for mental distress, as confinement and social distancing contributed to the general public's psychological distress and feelings of loneliness due to fear and uncertainty. Loneliness and isolation have been proven to increase depression and stress.[5] Published studies have shown that after major events such as the severe acute respiratory syndrome (SARS) outbreak, depression and anxiety tend to appear at greater rates,[6] and as a result, they appear to negatively affect one's mental health.[7] Moreover, the coronavirus disease 2019 (COVID-19) pandemic negatively impacted other aspects of society, such as the work market and the economy, which contributed to increasing the risk of depression and stress.[8] Supporting these claims, data derived from cross-sectional studies that took place in different countries using Web-based surveys reported high frequency of depressive and anxiety symptoms.[9,10] Furthermore, confinement at home may lead to sedentary behavior with a direct impact on sleep,[11] as studies from several countries showed that lockdowns had detrimental effects on the sleep quality of at least one-third of the subjects who participated.[12] These negative outcomes were accompanied with feelings of depression and anxiety in the general population.[13] In a general population–based study in Australia, almost half of the participants reported negative change in sleep quality during lockdown.[14]

The Current Study

One of the purposes of our study was to determine if the Greek aviation personnel experienced deterioration in their sleep quality during the pandemic. Government-mandated interventions to control the spread of the virus, and thus the disruption of mobility between destinations, brought the aviation sector to a halt. To sustain the aviation industry and related sector employees, the latter were faced with potential layoffs,[15] reduced working hours, suspensions with or without pay, and salary cuts.[16] Some airlines implemented further measures to contain their company expenses, such as changes to contracts and conditions of their remaining staff, to compete with their low-cost competitor carriers.[17] This uncertainty toward the future of their employment has been expressed as an emerging symptoms of anxiety, depression,[18] and sleep disorders[19] among commercial and military[20] flight personnel. Vocational requirements of aviation personnel already present health risks, such as circadian disruption due to shift work and flight schedules, mental stress demands associated with flight safety, and the sedentary nature of the job, which are detrimental to physiological and psychological health metrics.[19] Notwithstanding these already existing sleep problems, anxiety, and fatigue in flying cabin crew (CC) compared with the average population,[21] the year-by-year comparison revealed that during the pandemic, clinically noticeable symptoms were three times higher for depression and more than double for anxiety. More specifically, a study regarding CC mental health in May 2019, compared with April 2020—amid the pandemic—stated that 73% of the respondents' personal situation had deteriorated because of this health crisis.[22]

We aimed to assess the levels of depression, anxiety, and sleeping problems among flying personnel and the ground staff of the airports during the pandemic to recognize the stem of the problem. This study is an initiative of the Aeromedical Center of Thessaloniki, Greece, in an international effort to capture the impact of the pandemic in the aviation community.

METHODS

Research Design

We conducted a cross-sectional study at the Aeromedical Center of Thessaloniki, Greece, after the first and during the second and third pandemic waves, from the beginning of July 2020 to the end of August 2021.

Population and Sample

Five hundred forty-eight self-selected, anonymous aviation personnel participated in this self-administered survey, following

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approval by the Aeromedical Center of Thessaloniki (ethical approval no. 16002) after giving informed consent.

Sampling Technique

All airline personnel, including professional commercial pilots, helicopter pilots, military aviation pilots (class I), commercial aviation students (class I—student), CC, private pilots (class II), ground control employees and telecommunication experts (class IIIG), and drone users (class IIID), were eligible to participate with no other restrictions.

Data Collection Procedure

Participants were provided with either electronic or print questionnaires and could terminate the survey at any time.

Measures and Description Variables

Collected data included anthropometric characteristics, sociological and clinical factors, and scales assessing levels of fear, anxiety, depression, insomnia, stress, and burnout. The scales used were Patient Health Questionnaire 9 (PHQ-9), General Anxiety Disorder 7 (GAD-7), Epworth Sleepiness Scale, the Pittsburgh Sleep Quality Index (PSQI), Berlin Questionnaire, and a customized 9-point Likert-type scale to address COVID-19–related psychological, somatic symptoms, and sleep disturbances.

Sociological and clinical factors included sex, age, occupation within the aviation industry (class I, class I—student, class II, class III, CC) and total hours of flight, medical and psychiatric history ("Do you suffer from any other diseases? If so can you describe them to us?"), any medication ("Are you taking any medication? If so can you describe it to us?"), smoking habits (active smoker/smoking cessation/nonsmoker, pack-years), and body mass index (BMI) ("How many kilos do you weigh?" and "How tall are you?").

Psychometric scales included:

- Patient Health Questionnaire 9: It is a 9-item self-administered tool used to assess depression. The person filling the questionnaire is asked about symptoms that have been found to relate to depression over the past 2 weeks. Items are rated on a 4-point Likert-type scale ranging from 0 (not at all) to 3 (nearly every day). Total scores vary from 0 to 27. More specifically, scores between 0 and 4 are thought of as "minimal or none," scores between 5 and 9 as "mild," scores between 10 and 14 as "moderate to severe," and scores greater than 15 as "severe" signs of depression. A cutoff point of 10 or more is regarded to have a very high accuracy (close to 88%) of indicating major depression.[23]
- General Anxiety Disorder 7: It is a 7-item tool used for rating the severity of symptoms relating to anxiety, over the course of the past 2 weeks. Items are graded on a 4-point Likert-type scale, ranging from 0 (not at all) to 3 (nearly every day). Total scores vary from 0 to 21, from which scores of 0 to 4 are regarded as "normal," 5 to 9 as "mild, 10 to 14 as "moderate," and 15 or greater as "severe" symptoms of anxiety. A cutoff point of 10 or more is an indicator of clinical anxiety.[24]

Sleep scales included:

- Epworth Sleepiness Scale: It is an 8-item self-administered screening tool for daytime sleepiness. Specifically, the person filling in the questionnaire is asked about the likelihood of dozing off during certain daytime activities. Items are rated on a 4-point Likert-type scale, ranging from 0 (no possibility of dozing off) to 3 (high possibility of dozing off). Total scores range from 0 to 24. A cutoff point of a total score of 11 or more is used to refer to abnormal daytime sleepiness.[25]
- Pittsburgh Sleep Quality Index: It aims to assess the sleep quality of a person in the past 1 month. In total, there are nine large entries, of which entry 5 is divided into 10 subquestions. As a result, there are 18 total entries. Those entries make seven components, and each of them is rated on a 4-point scale, ranging from 0 to 3. The total score of the PSQI ranges from 0 to 21, and higher scores indicate a worse sleep quality. An aggregate score of more than 5 is indicative of sleep disturbances.[26]
- Berlin Questionnaire: It is a 10-item self-administered screening tool for risk factors of sleep apnea. The participants are asked about their snoring behavior (category 1, positive if the score is >2), daytime fatigue (category 2, positive if the score is >2), and comorbidity of obesity or hypertension (category 3 positive if the answer is yes, or if BMI is >30 kg/m^2). The person filling in the questionnaire is deemed as high risk if two or more categories are positive; otherwise, he/she is deemed at low risk of developing sleep apnea.[27]

To assess health-related anxiety, depression and sleeping difficulties due to SARS-CoV-2 infection or the COVID-19 pandemic as a whole, we created a customized 9-point Likert-type scale to address these issues. In this questionnaire, the participants were asked if they had contracted COVID-19 or not. Those infected answered the questionnaire related to their disease, whereas those not infected answered that regarding their views toward the pandemic. The questions included any feelings of anxiety or fear ("From not at all [1] to too much [9], how strongly do you feel anxiety, worry, fear, or other negative emotions?"); sleep difficulties ("From not at all [1] to too much [9], how intensely do you feel difficulty sleeping or maintaining your sleep?"); level of daily fatigue ("From not at all [1] to too much [9], how tired do you feel to carry out your daily activities?"); difficulties in physical activity ("From not at all [1] to too much [9], how strongly do you feel unable to walk or move?"), driving ("From not at all [1] to too much [9], how strongly do you find it difficult to drive?"), and working ("From not at all [1] to too much [9], how strongly do you find it difficult to work?"); and about dyspnea ("From not at all [1] to too much [9], how intensely do you feel difficulty breathing?"). Those questions were answered in a 9-point Likert-type scale ranging from 1 (not at all) to 9 (a lot). The last questions were about some aspects of their medical history. The questionnaire can be found in the Supplementary Material, http://links.lww.com/JOM/B123. This questionnaire has acceptable reliability, with Cronbach α's ranging between 0.58 and 0.77, accounting for 59.1%, and satisfied the requirement of Kaiser-Mayer-Olkin values (0.79). Bartlett test of sphericity was significant.

Method of Data Analysis

Statistical analysis was performed using MATLAB R2021a Release, Statistics and Machine Learning Toolbox™ (MathWorks Inc., Natick, MA). Descriptive statistics were used to present sociological and clinical factors and other COVID-related information and continuous outcome variables including, fear, anxiety, depression, and fatigue; categorical variables were expressed as absolute values (percentages), and continuous variables as mean (SD) values. Generalized linear regression models and multivariable logistic regression were used to examine the association between continuous and categorical variables and to determine independent associations of binary outcomes. Two-tailed P values of less than 0.05 were deemed statistically significant. Power analysis for a linear multiple regression was conducted in G*Power 3.1 (Heinrich Heine Universität Düsseldorf, Düsseldorf, Germany) to determine a sufficient sample size using an α of 0.05, a power of 0.80, and a small effect size ($f = 0.02$).[28] Based on the aforementioned assumptions, a total sample size of 485 participants would

TABLE 1. Summary of the Basic Information of the Sample

	n	Mean (SD)
Age	548	38.23 (13.56) y
Sex		%
Male	433	79.01
Female	115	20.99
Occupation		%
Class I	189	34.49
Class II	55	10.03
Class IIID	15	2.74
Class IIIG	42	7.66
Class I student	142	25.91
Cabin crew	105	19.71
Smoking status		
Current smoker	118	
Pack-years		8.25 (10.12)
Ex-smoker	84	
Pack-years		12.44 (11.36)
Nonsmokers	346	
COVID-19 infection		%
	39	7.22
Body mass index, kg/m^2		
Male		26.22 (3.53)
Female		22.66 (4.01)

be sufficient to detect significant interaction effects at the 0.05 level. This can be found in the Supplementary material, http://links.lww.com/JOM/B124. Our sample size is estimated to be 548, which is adequate for our experimental design and the analysis performed.

RESULTS

Five hundred forty-eight aviation personnel participated in the study with a mean age of 38.23 (SD, 13.56) years. The sample was predominantly male (79.01%), class I commercial, actively flying pilots (34.3%), nonsmokers (78.47%), and noninfected with SARS-CoV-2 (92.88%) for the duration of the study (Table 1).

Taking into account the results from the COVID-19 questionnaire, the pandemic has mostly forced people into negative emotions, such as anxiety and fear. It has also taken a toll on one's energy to perform daily activities and has dampened the respondent's ability to sleep or maintain their sleep. This conclusion stems from the fact that the corresponding questions (questions 1 to 3) yielded the highest mean scores. The main concern of the infected participants regarded their difficulty in carrying out their daily activities due to fatigue, as shown in Figure 1. Logistic regression analysis was used to test if infection with SARS-CoV-2 significantly predicted scores in each individual question of the COVID-19 questionnaire. It was also used to test if the hours of flight of class I pilots significantly predicted the scores of the same questions. The logistic regression analysis showed that whether a person has been infected only affects their difficulty walking ($P = 0.0193$) and working ($P = 0.0098$) due to the pandemic, as well as its psychological toll ($P = 0.026$). Focusing on class I actively flying pilots, their workload (ie, hours of flight) since the start of the pandemic, had a statistically significant effect only on their mental state regarding the pandemic ($P = 0.048$) and none of the scores of the rest of the COVID-19 questionnaire domains.

We divided the smokers into three categories: 0 to 5, 6 to 10, and 11 or more pack-years. These ordinal (categorical but with ascending order) data were used in logistic regression analysis to test whether they are significant predictors of the scores in each question of the COVID-19 questionnaire. It was found that there is a statistically significant positive correlation between the number of pack-years and difficulty in breathing ($P = 0.0169$) and walking ($P = 0.0479$). We also divided the participants into four groups, depending on their BMI: underweight (below 18.5 kg/m^2), normal (18.5 to 24.9 kg/m^2), overweight (25 to 29.9 kg/m^2), and obese (30 kg/m^2 or more). Looking at the BMI as ordinal data, logistic regression analysis was used to test if BMI category significantly predicted the scores in each question of the COVID-19 questionnaire. Body mass index had a statistically significant positive effect on daily tiredness and fatigue ($P = 0.0175$) and on the participant's difficulty in sleeping and maintaining their sleep ($P = 0.0072$), walking ($P = 0.0001$), breathing ($P = 0.0109$), and driving ($P = 0.0005$), all due to the pandemic.

The total levels of severity, by sex as well as by occupation, are illustrated in Table 2 and Figure 2. It was revealed that 8.21% of the aviation personnel had at least mild symptoms of depression and 5.83% at least mild anxiety. We should mention here that, as aviation workers are regularly interviewed by a psychiatrist, none had any history of psychiatric illness. Logistic regression analysis was used to test if the scores in each question of the COVID-19 questionnaire significantly predicted the scores on any of the other questionnaires used in the study. The logistic regression analysis showed that there was a statistically significant association of the level of perceived stress and physical symptoms (difficulty breathing and walking) due to COVID-19 with a higher likelihood of exhibiting symptoms of depression ($P < 0.000$, $P = 0.0002$, and $P < 0.000$, respectively). It also showed that difficulty working, walking, and breathing, as well as fear about the psychological consequences, were significant predictors of anxiety ($P = 0.0318$, $P < 0.000$, $P < 0.000$, and $P < 0.000$, respectively). Logistic regression analysis was used to test if sex significantly predicted PHQ-9, GAD-7, PHQI, Berlin, and Pittsburgh questionnaires' scores and also if sex significantly predicted above-the-cutoff scores on the same questionnaires. The analysis showed that the female sex

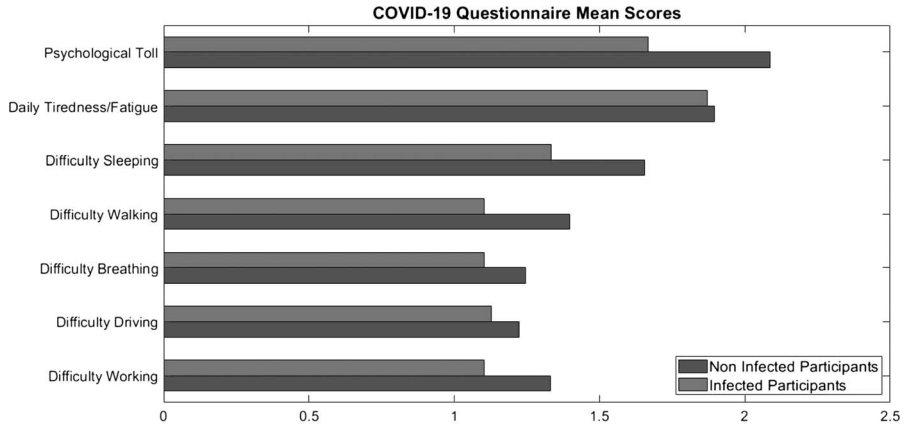

FIGURE 1. Mean score for each element of the COVID-19 questionnaire for infected and noninfected participants.

TABLE 2. Main Outcomes of the Psychometric and Sleep Scales

	Class I	Class II	Class IIIG	Class IIID	Class I Student	Cabin Crew	Total (M/F)
Berlin							
Above cutoff	7	0	2	0	0	8	17 (9/8)
Below cutoff	182	55	40	15	142	97	531 (424/107)
Pittsburgh							
Above cutoff	40	20	11	3	28	37	139 (102/37)
Below cutoff	149	35	33	12	114	68	409 (331/78)
Epworth							
Above cutoff	10	4	2	0	13	8	37 (29/8)
Below cutoff	178	51	40	15	129	97	511 (404/107)
PHQ-9							
Normal	173	47	40	15	137	91	503 (403/100)
Mild	14	5	1	0	4	11	35 (23/12)
Moderate/severe	2	3	1	0	1	3	10 (7/3)
GAD-7							
Normal	180	49	40	15	136	96	516 (401/105)
Mild	7	4	1	0	6	7	25 (17/8)
Moderate/severe	2	2	1	0	0	2	7 (5/2)

GAD-7, General Anxiety Disorder 7; PHQ-9, Patient Health Questionnaire 9.

significantly predicted the scores of the PSQI ($P = 0.0017$), the Epworth questionnaire ($P = 0.0122$), and the GAD-7 ($P = 0.0085$). However, looking at the results as continuous data, female sex significantly predicted above-the-cutoff scores on the Berlin questionnaire ($P = 0.0125$), the PSQI ($P = 0.05$), and the PHQ-9 ($P = 0.0332$).

Logistic regression analysis was used to test if scores on each of the questions on the COVID-19 questionnaire significantly predicted above-the-cutoff scores on the sleep scales. It was found that daily tiredness and fatigue due to the pandemic significantly predicted above-the-cutoff scores on all the sleep scales (Berlin questionnaire, $P = 0.0011$; Epworth questionnaire, $P = 0.001$; PSQI, $P = 0.0147$). Difficulty sleeping and maintaining sleep due to the pandemic also significantly predicted above-the-cutoff scores on all the sleep scales (Berlin questionnaire, $P < 0.000$; Epworth questionnaire, $P = 0.011$; PSQI, $P = 0.0227$). This was also true for difficulty walking due to the pandemic (Berlin questionnaire, $P < 0.000$; Epworth questionnaire, $P < 0.000$; PSQI, $P = 0.0034$). Difficulty breathing due to the pandemic significantly predicted above-the-cutoff scores on the Berlin ($P = 0.002$) and the Epworth questionnaire ($P < 0.000$). Difficulty working due to the pandemic significantly predicted above-the-cutoff scores only on the Epworth questionnaire ($P < 0.000$). According to the regression analysis model, participants with above-the-cutoff scores on the Epworth questionnaire also presented with worse scores on the other sleep scales (Berlin questionnaire, $P = 0.0001$; PSQI, $P < 0.000$) and difficulty to work due to the pandemic ($P < 0.000$).

Logistic regression analysis was used to test if smoking habit and amount of pack-years significantly predicted scoring above-the-cutoff point on all the psychometric and sleep scales. The analysis showed that currently smoking participants mostly scored above-the-cutoff point for the Epworth questionnaire ($P = 0.013$). There was also a statistically significant positive correlation between the amount of pack-years and the outcome of the Berlin questionnaire (0.0108), when we divide smokers into the three aforementioned categories. Finally, logistic regression analysis showed that BMI of the participants also seems to have a strong statistically significant positive effect on the Berlin questionnaire's scores ($P < 0.000$).

For the CC specifically, a significant proportion reported at least mild symptoms of depression, anxiety, fatigue, and sleeping difficulties. The logistic regression analysis showed that when the entire population of subjects is examined, women tend to have statistically significant worse scores than men, as mentioned previously. This is also evident in Figure 2. Cabin crew has also collectively yielded

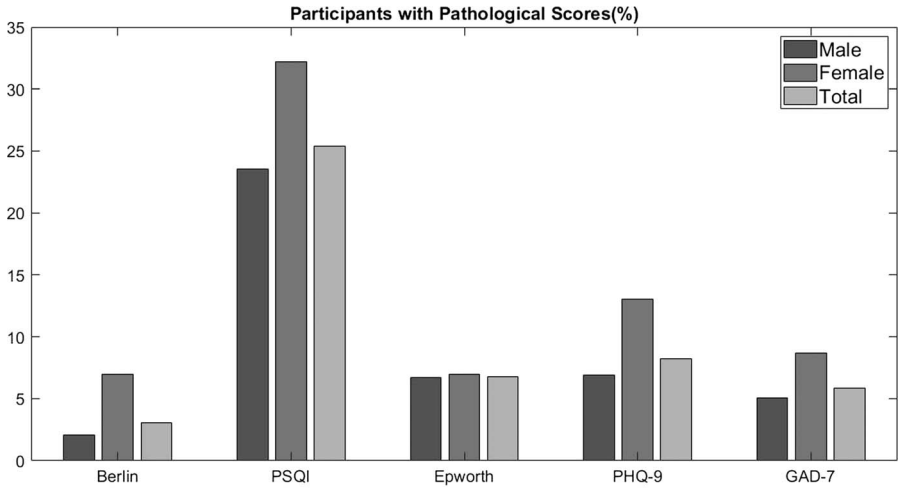

FIGURE 2. Percentage of participants scoring above the cutoff point on each of the scales, for different sexes, and collectively.

worse scores compared with all the other classes. The logistic regression analysis showed that participants within the CC category have significantly higher scores on the PHQ-9 ($P = 0.0335$), GAD-7 ($P = 0.0027$), the Epworth questionnaire ($P = 0.0166$), and the PSQI ($P < 0.000$). However, when looking at the CC population as a whole, there is no statistically significant difference between men and women.

DISCUSSION

To our knowledge, this is the first national study to report on the prevalence and correlates of depression, anxiety, and sleep difficulties in aviation workers in Greece, during the COVID-19 pandemic. Our sample is small, and results would be more significant with more respondents. Nevertheless, we believe our population to be representative of aviation workers and their mentality because all of our subjects continued to be employed by the aviation industry during the pandemic. Whether we study the sample as part of the general population or as an isolated population group, our outcomes are in correspondence with the international literature.

Theoretical Implications of the Study

The greatest concern of the entire sample of participants due to the pandemic related to stress, fear of COVID-19, and other negative emotions. In a general population study in Greece during the first wave of the pandemic, only 0.4% of participants reported severe depressive symptoms on the PHQ-9,[29] a finding similar to our study where 0.7% of aviation workers reported severe depression. In a similar study on the general Greek population, 8.5% of participants experienced distress due to the pandemic,[30] whereas 8.2% of our participants stated at least mild depressive symptoms. However, there are some limitations in these comparisons. First, PHQ-9 cannot replace a clinical interview,[31] and with the results being self-reported, we can only comment on the trajectory of the symptoms, not on any disorder itself. Second, it is important to note the heterogeneity across the studies being compared, as in the second general-population study being mentioned previously, different assessment scales were utilized. Finally, the same level of representativeness in the studies is not guaranteed, as aviation workers constitute a unique population group, because of the aviation industry's sensitivity toward the outbreaks of viruses and world crises in the past.[32]

It might be improper to directly compare these results to pre–COVID-19 rates; however, the scores in our study seem to be lower when compared with other pre–COVID-19 aviation workers studies where, for example, 12.6% scored above the standard ≥10 cutoff point in an international Web survey of 1837 participants utilizing PHQ-9.[33] It is important to note here that during aviation workers' visits to their aeromedical examiner, they are at risk of having their medical certification revoked and are therefore reluctant to report major psychological distress that could jeopardize their fitness to fly and consequently their ability to work.[34] This sort of fear is far from imperceptible. Infectious diseases and pandemics have always brought great uncertainty to the aviation industry, especially affecting relative global revenues; however, the impact of COVID-19 is greater than the combined impact of the 9/11 terrorist attacks in 2001 and the financial crisis of 2008.[35] Interestingly, class II private pilots, whose livelihood is not directly correlated to their flying ability, reported the highest levels of depressive symptoms on the PHQ-9. Thus, trying to manage impressions in fear of stigmatization could be a possible explanation.

There are no known data that stem from other studies about the Greek aviation personnel concerning anxiety levels. However, our participants reported lower levels of distress compared with the rates described in the international literature, as shown in an international Web survey of aviation workers, utilizing GAD-7, where most stated at least mild symptoms of anxiety and more than 20% of the workers were reported to have moderate or severe levels of anxiety. However, half of the participants in this study had lost their jobs because of COVID-19, and only 20% were confident about their future employment within the aviation sector.[15] Nonetheless, our study was mostly conducted during visits to the aeromedical examiner, meaning that our participants were the ones not faced with layoffs during the pandemic, a fact that could explain the lower anxiety rates.

Our regression analysis model correlates anxiety and distress due to the pandemic with mental health deterioration, which is not a surprise and is also in line with the international literature,[36] as fear of infection[37] is a plausible explanation. A study from a Thai airline has shown that, despite the return-to-work intention, occupational exposure poses a major concern for flight personnel and their family members.[38] The high crowd densities in enclosed spaces of air transport increase the transmission risk,[39] and flight duration, which is significantly shorter than the incubation period, allows for most infected passengers to pass the screening implemented at the airports before any symptoms occur, thus proving it ineffective.[40] From another perspective, long, international flights increase the risk of infection or worsening of symptoms, because of travel fatigue, lack of sleep[39]—a profound risk factor for adverse health outcomes[41]—and the consequent immunocompromise.[42]

As difficulty working due to the pandemic was among the predictors of anxiety, another cause for the latter could be, except for the quarantine itself, the dramatic change in working schedules, which in some cases involved complete cessation in a company's professional activities. People who stayed in quarantine during past SARS outbreaks later documented symptoms of anxiety[43] and depression.[44,45] All mentioned symptoms have been present in the months following quarantine, and in some cases, they persisted even years after.[6] Moreover, time away from work, especially during the first and second waves of the pandemic poses a perceived risk of unemployment that has been shown to be among the predictive factors of mental distress.[46] For aviation workers in Greece, this constitutes a plausible scenario, as Europe has probably undergone the most significant changes regarding network connectivity,[47] with the effects of the pandemic on aviation industry being comparable to those from meta-analyses of unemployment.[48] As mentioned previously, anxiety (above-the-cutoff scoring on the GAD-7) in our study has been linked to physical symptoms such as difficulty breathing and working, a finding that could further be explained as job insecurity as the latter has been related to somatic symptoms.[49]

Our regression analysis model showed that the female sex was significantly associated with a higher likelihood of exhibiting symptoms of depression and anxiety perhaps due to female employees' reduced salary compared with their male counterparts, especially during the pandemic.[50] Women have indeed been found to be in more danger of suffering from such symptoms in general,[51] in the context of the pandemic[46] and when working within the aviation sector during the pandemic.[52] Moreover, women in Greece are more likely to display symptoms of depression and, more importantly, to report them.[30] Findings are not dissimilar across Europe because the female sex is often identified as a significant predictor of depression and anxiety due to the pandemic.[15]

Daily tiredness and fatigue due to the pandemic were among the main concerns of our sample, with 25.36% of the participants reporting sleep disturbances on the PSQI, especially those infected with SARS-CoV-2, a finding that is in accordance with the international literature. A meta-analysis of 250 international studies of approximately half a million participants, regarding sleep problems due to the pandemic, revealed that during the COVID-19 pandemic the pooled estimated prevalence of sleep disturbances (including poor sleep quality and insomnia) was 40%, higher than those of our sample population.[53] However, aviation workers' sleep is generally characterized by frequent disruptions due to flight schedules and the fatigue that the latter induces on them.[54] In a study investigating sleep alterations during the pandemic, participants with systematically irregular jobs

reported lesser sleep difficulties during this period.[55] In this study, social jetlag during lockdown for people with preexisting irregular sleeping patterns showed a stronger decrease during lockdown.[55] This could explain the smaller than the general population numbers of reported sleep problems in aviation workers in our study, who had a significant decrease in working hours due to the pandemic and managed to improve their sleep schedule. This is also evident from the fact that, regarding class I actively flying pilots' scores in our study, the higher the latter's workload (ie, hours of flight during the pandemic), the greater their COVID-19–related distress.

Difficulty walking and breathing as well as daily fatigue, translated as physical exhaustion due to the pandemic, was the main predictor of worsened sleep quality in our study, along with the female sex. Higher scoring in the question "Difficulty sleeping and maintaining sleep due to the pandemic" on the COVID-19 questionnaire yielded higher scores on all the sleep scales, a finding concurrent with other studies that significantly associated disposition for sleep difficulties with COVID-19–related agita.[55–57] Furthermore, women are consistently documented as having worse sleep quality than men, in our study, in the context of the pandemic[56] and in general, as they report a greater need for sleep, sleep insufficiency, and more insomnia than their male counterparts.[57,58] We speculate that these results could be attributed to quarantine and the consequent sedentary behavior and unhealthy lifestyle choices[19] it imposed on the general population,[14] and aviation employees specifically,[59] during lockdown. This explains the fact that worse scores on Epworth questionnaire, an index of daytime drowsiness, follow up with worse scores on the other sleep scales, as well as on the participant's difficulty to work. Healthy lifestyle interventions of pilots in quarantine have been shown to present fewer sleep disturbances,[19] supporting our findings, as smokers in our study declared greater levels of fatigue (ie, above cutoff scores on Epworth questionnaire). The positive correlation between number of pack-years and higher scores on the Berlin questionnaire, as well as difficulty in breathing and walking in our study, could be attributed to breathing problems caused by smoking, which is presented with snoring and less stamina.[60] Finally, obesity has been linked to worse sleep quality during lockdown,[61] as it has been similarly shown in our research.

Practical Implications of the Study

COVID-19 has been largely controlled in Greece during the first and second waves of the pandemic, which is reflected in the small representation of infected participants in our study. The patients were mainly concerned about their daily fatigue that hindered them from completing their daily activities, a finding largely attributed to SARS-CoV-2 infection.[62] Another observation that was deemed noteworthy is that many subjects infected by COVID-19 expressed difficulty in mobility and an ability to return to work. The reduced mobility may be caused by the detrimental effects of COVID-19 on the patient's cardiorespiratory and functional reserves,[63] and it could also be exacerbated by the psychological effects of the isolation and the disease as a whole.[64] As for the ability to return to work, COVID-19 still remains an illness with unknown long-term effects and many post-COVID complications, which in turn may affect or frighten a lot of subjects.[65] Interestingly, the infected aviation workers in our study did not complain at large about difficulty breathing and sleeping, a finding that contradicts the results of COVID-19–related studies on patients in general.[66] This could be attributed to the generally strict medical screening of aircrew members and the mandatory routine health check-ups, therefore constituting them a low-risk population for morbidity due to COVID-19.

Cabin crew plays a key role in ensuring cabin safety and maintaining customer satisfaction in commercial aviation. They are exposed both to a multitude of occupational hazards (poor cabin air quality, cosmic ionizing radiation, occupational noise, circadian rhythm disruption) and to constant contact with the passengers.[67] Their vulnerability to health issues[68] as well as the unpredictable nature of their job,[69] (ie, disruptive work schedules, direct contact with misbehaving passengers[70]), is consistently evident in literature, especially amid the pandemic.[71] A significant proportion of flight attendants in our study reported at least mild symptoms of depression (13.3%), anxiety (21.9%), and sleeping difficulties (35.2% above-the-cutoff score on the PSQI), much higher than all the other classes. This is a finding consistent with international studies, where flight attendants present higher prevalence of mental health and sleep problems[21,22] than the rest of the flying crew. We speculated that because women seem to also collectively yield worse scores than men in all domains and given the fact that 85.7% of CCs in our study are female, sex could constitute the main variant of these outcomes. However, this is not the case, as when the entire CC population is examined alone, there is no statistically significant difference between men and women, featuring the nature of the job as the reason for distress. Irregular working hours and circadian rhythm disruption, harassment,[21] and occupational exposure to SARS-CoV-2 in the cabin could constitute some risk factors for adverse mental health and sleep quality outcomes. Finally, with commercial aircrafts being flown with reduced capacity and fewer flight attendants being needed in the cabin, they are perhaps the most vulnerable population toward job insecurity, within the aviation community.[22]

CONCLUSION

Self-reported mental health problems were low in our study, but aviation workers are already at an increased risk of accumulated psychological pressure during this outbreak. While inspecting the content of the items used in aeromedical centers to assess mental health of flying crew, one could speculate that simply evaluating how "bothered" the respondent is by their recent problems is insufficient within the context of the pandemic. The latter constitutes a great shock with short-term exacerbation of one's feelings of hopelessness. For those who maintained their employment status such as the participants in our study, personal stability after anticipation of economic and social disruption could underestimate the day-to-day accumulating stress of this world crisis. In a different view, the strict psychological evaluation of class I professional pilots in aeromedical centers poses a serious threat to loss of their medical certification. Given the fact that class II private pilots, whose livelihood is not directly correlated to their flying ability, reported significantly higher levels of depressive symptoms, class I pilots trying to manage impressions could be a feasible explanation and is an issue that aeromedical examiners should be aware of, when conducting the standard evaluations.

Limitations and Future Studies

The study has some key limitations. It was a cross-sectional study, with the assessment of mental health and sleep disturbances being performed with self-reported tools that may vary from clinical interviews and polysomnographic recordings. As a result, reported difficulties may not necessarily translate to a clinical syndrome. Despite the total number of participants and the inclusion of different occupational groups from multiple sites in favor of heterogeneity that limits the generality of the results, our sample is likely to underestimate the mental health effects of COVID-19 in particular, as unfavorable assessment of aviation workers in aeromedical centers could jeopardize their ability to work. Future research is required to understand what aspects of the pandemic may have contributed to negative health outcomes and increase support for preventive treatment.

Finally, as CCs present higher prevalence of mental health and sleep problems, both in our study and in the international literature, they should be prioritized to ensure that they receive the tailored support they require from their aeromedical examiners. This is due to both the nature of their work (high contact rates with interior aircraft

surfaces and potentially infected passengers in an enclosed space) and also the aviation worker's ongoing fear around employment uncertainty. Therefore, the emergence of COVID-19 is a reminder that aeromedical evaluations require an observant state of mind and should involve pandemics as an element of overall risk of aircraft operations, exceeding prepandemic medical standard practices. Assessment should be, apart from compatible with the new safety requirements, proportionate to the exposure to occupational risks and most importantly safeguarded not to promote the nonpunitive reporting culture that could eventually sabotage worker's health and the aviation industries overall sustainability.

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