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International Journal of Aviation, Aeronautics, and Aerospace

Volume 9 | Issue 3 Article 2

2022

Comparison of Schedules, Stress, Sleep Problems, Fatigue, Mental Health and Well-being of Low Cost and Network Carrier Pilots

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Scholarly Commons Citation
Venus, M. (2022). Comparison of Schedules, Stress, Sleep Problems, Fatigue, Mental Health and Well-being of Low Cost and Network Carrier Pilots. *International Journal of Aviation, Aeronautics, and Aerospace, 9*(3). https://doi.org/10.15394/ijaaa.2022.1714

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Comparison of Schedules, Stress, Sleep Problems, Fatigue, Mental Health and Well-being of Low Cost and Network Carrier Pilots

Cover Page Footnote
I want to thank Alvarez IT Solutions for programming the online survey, IT security, and web hosting, as well as our informal network of very experienced pilots for their professional support, proofreading, and valuable background information for this research.

This article is available in International Journal of Aviation, Aeronautics, and Aerospace: https://commons.erau.edu/ijaaa/vol9/iss3/2

At the beginning of aviation more than a hundred years ago, flying was an adventure, later an absolute luxury. Pilots had an amazing life, in addition to high reputation, very comfortable working hours, a lot of free time, long layovers at dreamlike holiday destinations and a high income. That changed quickly when aviation was liberalized and, alongside the luxurious, expensive flag or network carriers (NWC, e.g., British Airways, Qantas, Lufthansa), low-cost airlines (LCC) launched a revolutionary new business model with new management methods. LCC opened up new markets, offered cheap flight tickets and made aviation accessible not only to the rich, but also to ordinary people. By implementing a consistent business model like NWC or LCC, this business model will entail different working conditions that are clearly distinguishable and measurable (Alamdari & Fagan, 2005; Pate & Beaumont, 2006). Previous studies have compared LCCs and NWCs regarding management strategies (ITF, 2002; Jean & Lohmann, 2016; Lohmann & Koo, 2013), looked at their effects on flight operations (ITF, 2002), working and employment conditions, and safety culture (Brannigan et al., 2019; Reader et al., 2016). Jackson and Earl (2006) also compared fatigue levels and general health of short- and long-haul pilots of LCCs and NWCs (Jackson & Earl, 2006). The present study was designed to compare actual rosters and working conditions of LCC and NWC pilots and, going further than previous studies, also compared their work-related and psychosocial stress, sleep restrictions, and other fatigue risks associated with flight duties, sleep problems, fatigue, and mental health issues (e.g., well-being, symptoms of depression, anxiety and common mental disorders (CMD)) of pilots flying for NWC or LCCs.

Problem

The International Transport Workers Federation (ITF, 2002) reported that NWC pilots earned 5% – 40% more, had 10% – 35% fewer flight hours, and 5% – 20% more days off or vacation entitlements compared with LCC pilots. LCCs operate predominantly short, and medium haul routes with minimal turnaround times, which can increase time pressure and work-related stress (examples Table 1). LCC pilots must cope with higher workload due to multiple short-haul or regional flights per flight duty period (Honn et al., 2016), restricted sleep and other fatigue risks due to flight duties (Roach et al., 2012; Vejvoda et al., 2014), higher fatigue levels (Jackson & Earl, 2006), and more frequent burnout (Fanjoy et al., 2010). LCCs usually recruit pilots with self-funded pilot training, which leaves pilots with high loans at the beginning of their careers (Brannigan et al., 2019).

Table 1

Different Types of Stressors and Examples of Stressors (Lundberg & Frankenhaeuser, 1999; McEwen, 2004, 2006; McEwen & Karatsoreos, 2015; McEwen & Stellar, 1993; Sapolsky, 2004; Spitzer & Williams, 2005; Ulich, 2001), and Stressors Especially Relevant for Pilots (Venus & grosse Holtforth, 2021a, 2022b)

Type of Stressor	Psychophysiological Stress Reactions

Physiological stressors	• Physical or mental effort, exertion
	• Extreme temperatures
	• Hunger, thirst
	• Accident, trauma,
	• infection, inflammation
	• sleep problems, insomnia
	• sleep restrictions
	    ○ roster-related
	    ○ due to irregular shift work
	    ○ due to frequently crossing time zones

Psychological Stressors	• anxiety • social defeat; humiliation; disappointment • realistic fear of a plane crash due to high fatigue
Psychosocial stressors	• health concerns (burnout, mental health issues) • partnership problems • childcare stress • financial problems • having no one to talk, etc.

Work-related stressors	• little experience in a cutting-edge cockpit
	• workplace conflicts (like investigation into pilots' private lives after fatigue reports, blaming pilots for their own fatigue)
	• time pressure due to
	    ○ economic pressure,
	    ○ minimum rest and turnaround times
	    ○ long flight duties in busy airspace, starting and ending at congested airports

Existential or chronic work-related stressors	• operators' impending bankruptcy or mergers (in the last years, e.g., Flybe, SunExpress, LATAM, Thomas Cook, Air Berlin, etc.) • job insecurity due to atypical contracts • 'Pilot Pushing' • responsibility for hundreds of passengers and crew during flight operations
Immediate threats to life/flight safety	• pilot blinded by laser pointer • drone encounters before touch-down • both pilots nodding off at the controls / in the cockpit • flying overhead active war zones (e.g., Syria, Ukraine, …)

Stress can be further exacerbated by the fact that many inexperienced LCC pilots are ‘self-employed’, or employed by intermediaries, where no employment contract between the LCC pilot and the air operator exists (Brannigan et al., 2019). A pilot with a temporary or atypical contract could feel pressured to work despite sickness, fatigue issues, career progression, etc., and might go on flight duty instead of calling in sick or fatigued (Brannigan et al., 2019; Cahill et al., 2021; Coombes et al., 2020; Cullen et al., 2020; Johansson & Melin, 2018; Venus, Greder & grosse Holtforth, 2022). This ‘profit over safety’ strategy was associated with a perceived ‘decay of safety culture’ and operational flight safety (Aljurf et al., 2018; Venus et al., 2022).

Definitions of Fatigue

The International Civil Aviation Organization (ICAO) defines fatigue as “*A physiological state of reduced mental or physical performance capability resulting from sleep loss, extended wakefulness, circadian phase, and/or workload (mental and/or physical activity) that can impair a person’s alertness and ability to adequately perform safety-related operational duties.”* Commission Regulation (EU) 2018/1042 links pilots’ fatigue, physical and mental health with flight safety. This study distinguishes between the dimension *alertness/sleepiness* and uses the term *fatigue* to describe long-term, accumulated fatigue that can deleteriously affect an individual’s performance, workplace and flight safety, as well as private life, in line with the definitions of the International Classification of Diseases 11 (ICD-11) and Shahid et al. (2010). A simple example: Sleepiness is a key symptom of fatigue and can be compensated for by adequately long, good-quality sleep. However, accumulated fatigue can reach a level of severity where legally required breaks (nights, rest days, holidays) are not enough to fully recover (Shahid et al., 2010; Venus et al., 2022).

Despite cutting-edge technology and highly automated flight management systems, fatigue-related performance decrements were identified as a threat to modern flight safety (Bandeira et al., 2018; Bendak & Rashid, 2020; Bourgeois-Bougrine, 2020; Coombes et al., 2020; Goode, 2003). In the 1980s, professional pilots flew an average of 45.7 ± 30 hours/month (M ± SD, Sloan & Cooper, 1986), while present flight time limitations allow up to 100 flight hours/month and up to 1000 flight hours/year (e.g., CASA FTL, 2013; EASA FTL, 2014; examples Appendix 1). High levels of fatigue were causal in or contributed to several plane crashes and accidents, including China Airlines 006 (NTSB, 1987), Korean Air 801 (NTSB, 2000), American Airlines 1420 (NTSB, 2001), and the TransAsia crashes (ASC, 2015, 2016). Furthermore, a high level of fatigue, combined with precarious working conditions, contributed to the Colgan Air 3407 crash (NTSB, 2010). Impaired mental health or several life events have played a substantial role in 17 commercial aviation accidents and incidents in past decade, in which 576 persons were killed (Mulder & de Rooy, 2018).

Fatigue and Mental Health Issues Among Pilots

Higher workload and more duty and flight hours were associated with increased 'sickness', and 'inappropriate presenteeism' (Cullen et al., 2020; Johansson & Melin, 2018; Venus, 2020; Venus & grosse Holtforth, 2021b, 2021a), decreased flight safety (Bandeira et al., 2018; Bourgeois-Bougrine, 2020; Goode, 2003), and high levels of fatigue among pilots (Aljurf et al., 2018; Reis et al., 2013, 2016a, 2016b; Venus et al., 2022; Venus & grosse Holtforth, 2021b, 2021a). Safety culture at LCCs was perceived to be inferior to safety culture at NWCs (Brannigan et al., 2019; Reader et al., 2016). Many pilots reported that fatigue reports did not lead to any improvements, but noticeable disadvantages (e.g., investigations into pilots' private lives, pilots' sleep-wake behavior on and off duty) (Bourgeois-Bougrine, 2020; Venus et al., 2022; Venus & grosse Holtforth, 2021a). This often overlooks the fact that still-legal, FRM-approved relentless rosters often result in pilots' accumulated fatigue, burnout (Demerouti et al., 2019; Fanjoy et al., 2010), and health impairment (Feijo et al., 2012; Venus et al., 2022). A pilot commented, *"I feel like there is no support if you were to call in fatigued [...] a focus on my personal life will be the center of attention, not the fact that I've worked 13 of the last 12 days rostered"* (Venus et al., 2022, p. 5). Severe unexpected fatigue on flight duty was reported by 9 of 10 pilots (90%), while only one of two pilots (50%) had reported being "not fit to fly" due to fatigue in the previous year (Venus, 2020; Venus & grosse Holtforth, 2021a, 2021b).

Accumulated Fatigue and Micro-Sleep in the Cockpit

If accumulated sleep debt (ICAO, 2015) cannot be recovered before commencing flight duties, fatigue can impair the sensory, cognitive, physical, and behavioral functions of flight crews (Chen et al., 2014; Coombes et al., 2020; Hartzler, 2014; McEwen, 2006; McEwen & Karatsoreos, 2015). *"Neurobehavioral performance effects of sleepiness reported by pilots include increasing pressure to fall asleep, degraded alertness, errors of omission and commission, deterioration in judgement and decision making, worsened mood, and deteriorating flying skills"* (Coombes et al., 2020, p.104833). Hartzler (2014) also reported fatigue-related performance decrements regarding divided attention, short-term memory, decision making, concentration, and deteriorated psychomotor and visual performance.

While it is difficult to measure these complex, multimodal performance decrements during active flight duties, micro-sleeps in the cockpit are valid manifestations of excessive fatigue and sleepiness on the flight deck. Fatigue-related incapacitation during micro-sleep events can be functionally similar to medical incapacitations (Coombes et al., 2020). Micro-sleep is defined as *"momentary loss of awareness when a person is fatigued or sleep-deprived, especially during monotonous tasks [for pilots, e.g., the cruise phase of flights]. Micro-sleep episodes can be noticed when the head literally drops forward and can last from less than one second to minutes"* (APA, 2021).

Situational awareness is essential for flight safety, but when a pilot accidentally falls asleep at the controls, situational awareness is gone. After micro-sleep events, pilots need time to reorient themselves at the controls. If both pilots accidentally doze off at the same time, the redundancy that is essential for flight safety, completely disappears. Per 2,000 flight hours, 1.1 cases were reported in which both pilots fell asleep from fatigue or exhaustion without prior coordination (Coombes et al., 2020). In May 2022, a dramatic case made headlines. One of the two pilots on duty had been taking his controlled rest, while the pilot in command had allegedly accidentally fallen asleep at the controls, on the night flight back from the USA to Italy. This pilot in command was immediately fired. Micro-sleeps in the cockpit are reported by 20% – 45% of pilots (Aljurf et al., 2018; Williamson & Friswell, 2017). Two-thirds of the investigated pilots reported fatigue-related errors during active flight duty. These facts suggest that fatigue risk management is less effective than expected (Bourgeois-Bougrine, 2020; Venus et al., 2022; Venus & grosse Holtforth, 2021b, 2021a).

Multiple Stressors for Aircrews

Recent research has revealed that work-related and psychosocial stress has become a major concern for pilots and cabin crew members. Today, FTL allow up to 100 flight hours per month and 1000 flight hours per year, while pilots only reported 47 flight hours/month in the 1980's (Sloan & Cooper, 1986). Looking at general and pilot-specific stressors (Table 1), LCC have to bear higher workload, more sleep restrictions and more time pressure. Previous research reported considerable interactions of stress, fatigue, mental health, and well-being (Cahill et al., 2021; Cullen et al., 2020; Omholt et al., 2017; Venus et al., 2022; Venus & grosse Holtforth, 2021a, 2022b). The Theory of Allostasis includes sleep deprivation and sleep problems as significant stressors (McEwen, 2004, 2006, 2008; McEwen & Karatsoreos, 2015; McEwen & Stellar, 1993; Metlaine et al., 2018), and seems to be applicable to pilots and other populations. The growing number of existential stressors associated with working several kilometers above ground, could enhance fatigue levels and impair physical and mental health (Sykes et al., 2012; Venus & Grosse Holtforth, 2022). LCC pilots could be even more affected than NWC pilots, due to more work-related and psychosocial stressors.

Research Questions and Hypotheses

Stress could contribute to sleep problems and high levels of fatigue and may also negatively affect pilots' mental health (Venus et al., 2022; Venus & grosse Holtforth, 2021a, 2022b). Pilots and pilot representatives uttered their concerns about dangerously high fatigue levels, especially among LCC pilots. Nevertheless, to our knowledge, no studies have reported NWC and LCC pilots' working conditions, rosters, stress levels, sleep problems, effectively measured fatigue (not acute sleepiness), overall well-being, symptoms of depression, generalized anxiety, and CMD up until today. Jackson and Earl (2006) analyzed the general fatigue and health perceptions of short- and long-haul pilots of LCC and NWC, but did not evaluate actual rosters, working conditions, mental health and well-being in detail. Based on the above referenced body of research, the following hypotheses will be tested:

H.1: Pilots of LCC report to be scheduled for significantly
a) more duty hours and/or
b) more flight hours, and/or
c) more flown sectors, and/or
d) more standby days, and/or
e) more night flights, and/or
f) more early starts than pilots of NWC.

H.2: LCC pilots report significantly
a) more psychosocial stress and/or
b) more work-related stress in terms of significantly lower perceived job security, and/or
c) less experience (flight hours) on their present type of aircraft, and/or
e) lower income than NWC pilots.

Studies have reported that airline pilots' fatigue was associated with psychosocial stress (Sloan & Cooper, 1986; Venus & grosse Holtforth, 2021a; 2022b; Widyahening, 2007), in line with the theory of allostasis (McEwen, 2006; McEwen & Karatsoreos, 2015). Sleep deprivation has been linked to impairments in mood and performance (McClung, 2013; O'Hagan et al., 2019), while higher workload was associated with increased mental impairment (O'Hagan et al., 2017) and CMDs (Feijo et al., 2012). Severe fatigue was reported by 68.3%–90% of pilots (Aljurf et al., 2018; Jackson & Earl, 2006; Reis et al., 2016a; Venus & grosse Holtforth, 2021a,b; 2022a,b); 24%–34% of pilots reported significant sleep problems (Aljurf et al., 2018; Reis et al., 2016b; Venus & grosse Holtforth, 2022b); 13.4%–34.5% of pilots reported significant depression symptoms (Aljurf et al., 2018; Cahill et al., 2021; Venus & Grosse Holtforth, 2022; Wu et al., 2016); and 8%–40.2% pilots reported abnormal anxiety scores (Aljurf et al., 2018; Venus & grosse Holtforth, 2021b). A recent study reported highly significant correlations between psychosocial stress, sleep problems, fatigue, mental health variables, and well-being (Venus et al., 2022; Venus & grosse Holtforth, 2021a).

The differences between NWCs and LCCs have narrowed over the past decade, accompanied by a consequent deterioration in working conditions and pay (Brannigan et al., 2019; Jean & Lohmann, 2016; Lohmann & Koo, 2013). The mentioned stressors may represent a particular burden for LCC pilots, which may negatively affect their sleep and fatigue. Jackson and Earl (2006) reported that 75%

DOI: https://doi.org/10.15394/ijaaa.2022.1714

of LCC short-haul pilots reported severe fatigue, while 80% reported considerable performance decrements due to fatigue. LCC pilots reported more often high fatigue levels and more impaired health, as would be expected in line with the theory of allostasis (McEwen, 2004, 2006; McEwen & Karatsoreos, 2015; Sapolsky, 2004). Against this backdrop, the present study has also been designed to test the following hypothesis:

H.3: LCC pilots report significantly
a) more sleep problems, and/or
b) higher levels of fatigue, and/or
c) more symptoms of depression, and/or
d) more symptoms of anxiety, and/or
e) more symptoms of common mental disorders and/or
f) more impaired wellbeing and/or
g) more days of sick leave in the last year, and/or
h) more days off due to fatigue, compared with pilots of NWC.

Material and Method

Procedure

The Ethics Committee of the Faculty of Philosophy and Human Sciences at the University of Bern reviewed the project and assigned approval no. 2018-05-00008. Data for this study was collected using a cross-sectional online survey programmed with Lime Survey®. This first exploratory study intended to analyze differences between LCC and NWC pilots' working conditions, rosters, stress, sleep difficulties, fatigue, mental health, and well-being. The link to the online survey was emailed by European and Australian pilot unions. The data collection took place from June 2018 to March 2019 in the main flying season, several months before the start of the Covid19 pandemic. The link was sent embedded with other messages and surveys in newsletters. The purpose and confidentiality of the study were explained, and participants were asked to provide their flight plans or duty rosters for the past two months. Participants could stop and discard their data at any time without any consequences.

Participants

The online survey was completed by 338 active professional pilots (185 NWC pilots and 153 LCC pilots). NWC are those, who operate network hubs and were the original 'flag-carriers', like British Airways, Emirates, KLM, Qantas, etc. LCC like Ryanair, Wizzair, SunExpress, Virgin etc. were founded decades later, advertised cheap tickets and generally operate point-to-point connections, often on secondary or regional airports. The purpose of this study was to assess as many working conditions and potential stressors as possible, like time pressure, long duty days, more duty hours per month, job-insecurity (due to e.g., limited contracts, 'self-employment'). Pilots' age and other sociodemographic and roster-related data are displayed in Table 2.

Of the NWC pilots, 48.6% were captains, 51.4% first officers. Of the LCC, 45.8% reported the rank captain, 54.2% first officer, with no significant distribution differences (χ^2 (1)=0.282; p<0.595). Most pilots (70%) were flying short and medium haul (sectors < 6 h), 30% long haul. Significantly more LCC pilots reported flying short haul (85%), compared with 57% short-haul pilots flying for NWC (χ^2 (1)=31.45; p<0.001). Overall, 7.1% of NWC pilots and 8.5% of LCC pilots were female, with no gender differences between NWC and LCC pilots (p=0.89).

Material

The cross-sectional online survey asked for pilots' age, sex, monthly income, and other sociodemographic data. We also asked for perceived job security, number of flying hours on the pilot's current aircraft, total flight hours, days of sick and fatigue leave, as well as duty and flight hours, flown sectors, standby, rest, vacation days, early starts (between 5:00 a.m. and 6:59 a.m.), night flights (flights including timespan from 11:00 p.m. to 06:29 a.m. partly or completely), and hours of physical exercise. Pilots were also asked to rate the frequency of microsleeps in the cockpit, fatigue-related incidents, and days off due to fatigue and sickness. We measured fatigue in terms of accumulated, long-term impairment with the nine items Fatigue Severity Scale of Krupp et al. (1989). Sleep problems were self-assessed with the Jenkins Sleep Scale (JSS) (Jenkins et al., 1988). Cronbach's alpha, scale range, cut-off values of all used scales are displayed in Table 3, items of all used standard questionnaires in Appendix 2.

Psychosocial stress was measured with the Brief Patient Health Questionnaire (PHQ-Stress) (Spitzer & Williams, 2005). Pilots' well-being was assessed with WHO5 (Krieger et al., 2014; Winther Topp et al., 2015). Depression symptoms were self-assessed with the Patient-Health-Questionnaire-8 (PHQ8) (Kroenke et al., 2009; Spitzer & Williams, 2005).

DOI: https://doi.org/10.15394/ijaaa.2022.1714

Table 2

Descriptive Statistics of the Dependent Variables of Multivariate GLM of the 338 Pilots Investigated in this Study

Variable	NWC M±SD	LCC M±SD	NWC-LCC in %[++]
monthly net income (converted to €)	7185±3756*	5963±2617	-17%
number of flight hours on present type of aircraft	4202±3918	4225±3550	
total number of flight hours	10,090±6278**	8385±5980	-17%
age	42.5±10.5**	39.1±10.1	-8%
duty hours[+]	107.8±33.8	115.4±36	+7%
flight hours[+]	62.35±19.1	66.31±22.18	+6%
flown sectors/legs[+]	66.6±46.1**	89.45±55.9	+34%
standby days[+]	1.82±2.47**	2.78±2.49	+53%
rest days (no vacation)[+]	10.35±3.28	10.45±3.24	
days of vacation[+]	1.79±4.41	1.64±3.98	
early starts (between 05:00 a.m. to 06:59 a.m.)[+]	4.30±3.97*	5.57±5.19	+30%
night flights (11:00 p.m. to 06:29 a.m.)[+]	3.77±3.33	4.01±5.55	+6%
days of sick leave[+]	0.49±2.67**	0.64±2.07	+30%
duty-days off due to fatigue[+]	0.13±0.81	0.13±0.41	
days “unfit to fly” due to fatigue (last year)	0.93±1.69*	1.64±2.64	+76%
days “unfit to fly” due to sickness (last year)	7.65±16.36	6.49±7.73	+16%
hours of physical exercise[+]	13.6±11	14.64±12.14	+7%
psychosocial stress (PHQ-Stress)	4.69±3.53	5.37±3.41	+15%
fatigue (FSS)	4.39±1*	4.65±0.90	+6%
sleep problems (JSS)	1.93±1.1*	2.24±1.15	+16%
well-being (WHO5)	58.1±19.1**	51.04±19.53	-13%
symptoms of depression (PHQ-8)	5.23±4.21*	6.34±4.65	+21%
symptoms of anxiety (GAD-7)	3.51±3.63	4.31±3.72	+22%
symptoms of CMD (SRQ-20)	3.75±4.03	4.41±4.20	+17%

Note.

+) Means and standard deviations of the last 2 months were used

++) Mean differences (NWC – LCC) in percent (%) are displayed for variables with significant between-group differences

GLM: significant differences between pilots of NWC and LCC: * $p< 0.05$; ** $p<0.01$

Symptoms of generalized anxiety were measured with the questionnaire “Generalized Anxiety Disorder 7” (GAD7) (Spitzer et al., 2006; Spitzer & Williams, 2005). We also assessed common mental disorders (CMD) with the Self Report Questionnaire 20 (SRQ20) (de Paula et al., 2017; Feijo et al., 2012). CMD include not yet pathologic impairment of well-being (e.g., headache, feeling nervous, and impaired mood), often caused by psychosocial and work-related stress.

Table 3

Range, Published and Used Cut-off Values and Cronbach's Alpha for Internal Consistency in this Study (N=338 international pilots) and Cronbach's Alpha Reported in Previous Studies

Scale	Scale Range	Cut-Off Value	Cronbach's Alpha in this study	Cronbach's Alpha (previous research)
WHO5 Well-being Index	1–100	< 50* < 29**	0.89	0.83–0.95 (Krieger et al., 2014)
Self-Reporting questionnaire SRQ-20 (CMD)	0–20	≥ 8	0.87	0.86 (de Paula et al., 2017)
Depression-screening PHQ8	0–24	≥ 10§	0.90	0.82 (Kroenke et al., 2009)
Anxiety screening GAD7	0–21	≥ 10§§	0.90	0.92 (Spitzer et al., 2006)
Fatigue Severity Score 9 items FSS	1–7	≥ 4+ ≥ 5++	0.82	0.93 (Valko et al., 2008) 0.88 (Lerdal et al., 2005)
Jenkins Sleep Scale JSS	0–5	≥ 4&	0.85	0.84 (Jenkins et al., 1988)
PHQ-Stress	0–20		0.81	

Note.

* WHO5: PR 29–50: Low well-being; diagnosis or exclusion of a depressive disorder recommended (Krieger et al., 2014)

** WHO5 ≤ 28: Very low well-being, diagnosis or exclusion of major depression recommended (Krieger et al., 2014)

§ PHQ8 ≥ 10: positive depression screening result: diagnosis or exclusion of a depressive disorder recommended

§§ GAD-7 ≥ 10; positive anxiety screening result: diagnosis or exclusion of a generalized anxiety disorder recommended

\+ FSS ≥ 4: severe fatigue (Aljurf et al., 2018; Lerdal et al., 2005; Reis et al., 2016b; Valko et al., 2008)

++ FSS ≥ 5: very high fatigue (Lerdal et al., 2005)

& considerable sleep problems in 15 or more nights per month

Statistical Analysis

SPSS version 27.0 (Statistical Package for Windows by SPSS Inc., Chicago, IL, US) was used for statistical analyses, $p<0.05$ was considered statistically significant. For sample description, Chi-Square (χ^2) tests were used to compare categorical data. For psychosocial stress, sleep problems, fatigue, well-being, symptoms of depression, generalized anxiety, and CMD, the item scores were added to compute scale scores. For JSS and FSS, the mean scale scores were used. Hypotheses H.1, H.2, and H.3 were tested with a multivariate general linear model (GLM) with the fixed factor LCC vs. NWC pilots. The dependent variables were

DOI: https://doi.org/10.15394/ijaaa.2022.1714

age, income, job security, experience on pilots' present type of aircraft, total flight experience (logged flight hours), roster data (such as duty and flight hours, early starts, and night flights, etc.), sick leave and absence due to fatigue, hours of physical exercise, psychosocial stress (PHQ-Stress), fatigue (FSS), sleep problems (JSS), well-being (WHO-5), symptoms of depression (PHQ-8), anxiety (GAD-7), and CMD (SRQ-20, all items in Appendix 2). The GLM was calculated to minimize the α-error, compared with univariate t-tests. If the prerequisites for parametric tests were not met, further analyses were conducted with nonparametric tests such as median tests or Mann–Whitney U tests for independent samples.

Results

Significantly more LCC pilots reported atypical contracts with the operator they were working for (χ^2 (6)=19.35; p=0.004, Table 4). Of the NWC pilots, 95.1% had a traditional employment contract directly with their employer, compared with 85.6% of LCC pilots. Furthermore, 94.6% of the NWC and 93.5% LCC pilots had an unlimited working contract, the rest had temporary contracts with no significant between-group differences (χ^2 (2)=1.97; p=0.737). Difficulties repaying their loan for pilot training were reported by 11% pilots, with no differences between NWC and LCC.

Table 4

Comparison of Contracts of Pilots Flying for NWC and LCC (N=338 pilots in this study)

		No response	Empl. con-tract w/ airline	A-typical empl. A*	A-typical empl. B **	A-typical empl. C***	A-typical: Pay to Fly	No con-tract	
NWC	n	3	176	3	1	0	0	2	185
	%	0.9%	52.1%	0.9%	0.3%	0.0%	0.0%	0.6%	54.7%
LCC	n	3	131	1	13	1	3	1	153
	%	0.9%	38.8%	0.3%	3.8%	0.3%	0.9%	0.3%	45.3%
Total	n	6	307	4	14	1	3	3	338
	%	1.8%	90.8%	1.2%	4.1%	0.3%	0.9%	0.9%	100.0%

Note.
*) Employment contract via an intermediary manning agency
**) Self-employed (own company) with a direct contract with the airline
***) Self-employed (own company) and contract with intermediary agency

In the complex, multivariate group comparison with GLM, the fixed factor was NWC vs. LCC (Tables 2, 5). The dependent variables are described in chapter Material, M±SD are displayed in Table 2. Levene's test of equality of error variances was significant for monthly income, operator stability, job security, and days "unfit to fly" due to fatigue during the last year. Therefore, these variables were further analyzed with separate nonparametric tests. Mean differences in percent (%) between data reported by NWC and LCC pilots in this study (regarding rosters, sleep, fatigue, mental health, and well-being) are displayed in Figure 2. In the multivariate analysis, the fixed factor was highly significant ($F(27,229)=2.639$; $p<0.001$, Eta Square=0,237). The tests of between-subject effects were significant for several variables (Tables 2, 5).

Table 5

Multivariate GLM: Tests of Between-Subjects Effects of the groups NWC and LCC pilots in this study (N=338)

Dependent Variable	Df	F	Sig.	Partial Eta Square
number of flying hours on the present type of aircraft	1	.002	.962	.000
total number of flight hours	1	4.940	.027	.019
age	1	7.096	.008	.027
duty hours	1	0.562	.454	.002
flying hours	1	0.013	.910	.000
flown sectors/legs	1	13.27	.000	.049
standby days	1	9.459	.002	.036
rest days / off duty (no vacation)	1	0.072	.789	.000
days of vacation	1	0.082	.775	.000
early starts (between 05:00 a.m. to 06:59 a.m.)	1	4.904	.028	.019
night flights (incl. time from 11:00 p.m. to 06:29 a.m.)	1	0.175	.676	.001
days of sick leave	1	0.281	.597	.001
fatigue leave	1	0.008	.929	.000
days “unfit to fly” due to sickness, last year	1	0.514	.474	.002
number of hours of physical exercise last month:	1	0.526	.469	.002
WHO5_PR	1	8.523	.004	.032
PHQ-8	1	4.032	.046	.016
GAD-7	1	3.031	.083	.012
SRQ-20	1	1.665	.198	.006
PHQ-Stress	1	2.459	.118	.010
FSS	1	4.491	.035	.017
JSS	1	4.602	.033	.018

Note. Partial Eta Square = effect size

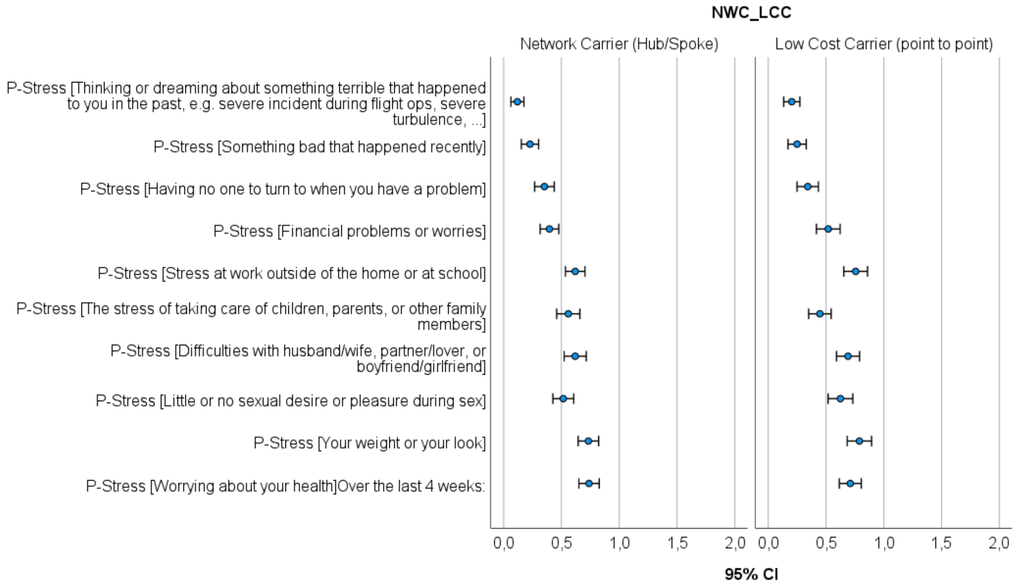
Hypothesis H.1 was partially confirmed: LCC pilots reported significantly more flown sectors per month, significantly more standby days, and significantly more early starts. In general, LCC pilots reported more demanding rosters.

Hypothesis H.2 was partially confirmed: LCC pilots reported significantly more work-related stressors, i.e., less total flight experience in terms of total flight hours, corresponding with LCC pilots' significantly younger age. The difference between NWC and LCC pilots' monthly income was significant (5.415; median=6000.00; $p=0.020$), NWC pilots earned on average about 17% more than

LCC pilots (5963.69±2617.17). LCC pilots perceived their job security significantly lower (median=3.960; mean=4; p=0.047). LCC reported slightly more psychosocial stress, although the difference was not significant (Figure 1).

Figure 1

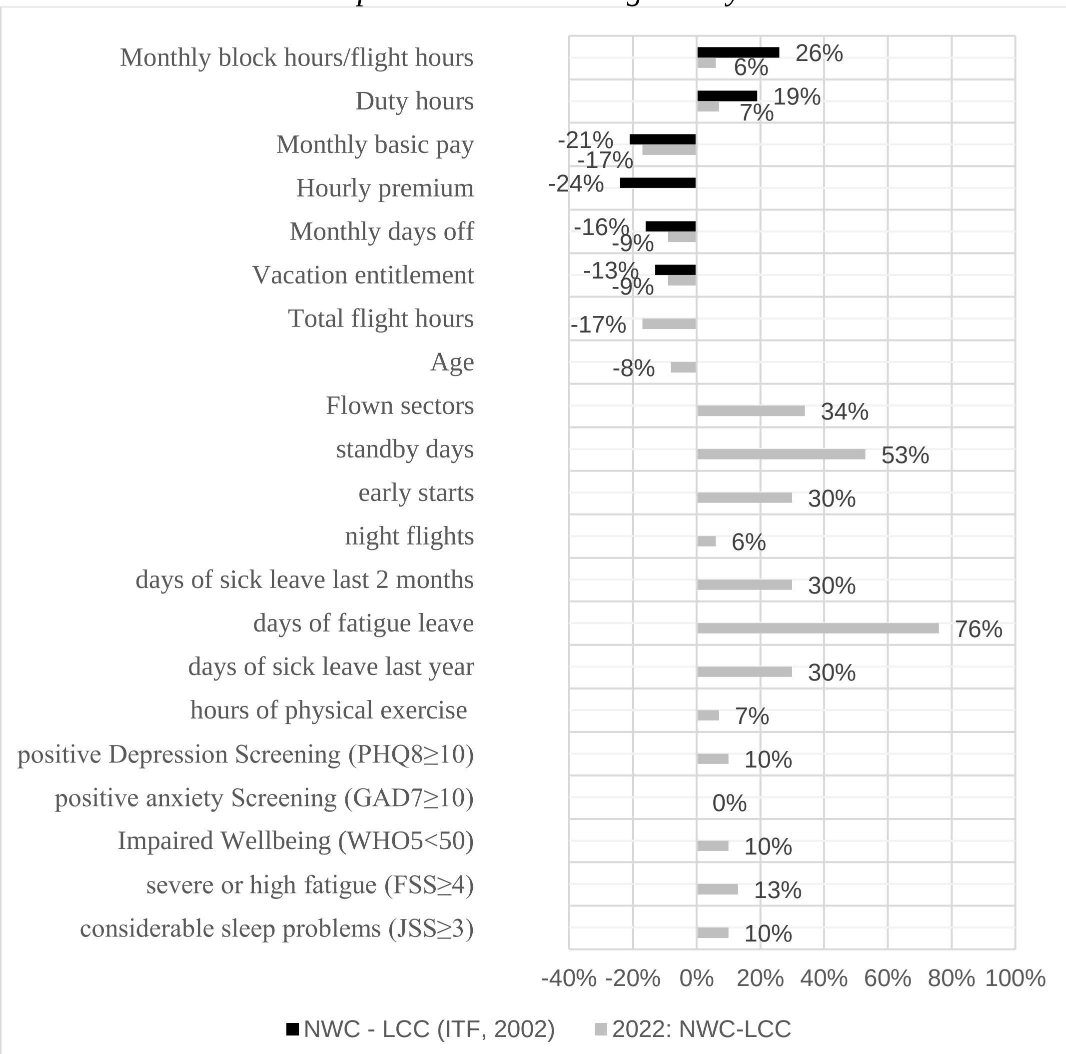
Mean Item Scores (CI 95%) for Psychosocial Stressors (PHQ-Stress) of NWC and LCC pilots in this Study



Hypothesis H.3 was also partially confirmed: LCC pilots reported significantly higher fatigue levels, significantly more sleep problems, significantly more impaired well-being, and significantly more symptoms of depression. LCC pilots reported slightly more symptoms of anxiety, and significantly more symptoms of CMD. LCC pilots reported on average 0.93±1.69 days "unfit to fly" due to fatigue *in the last year* (Mann–Whitney U=1.901; p=0.047), and *in the last two months* (0.64±2.07). Both groups reported falling asleep equally often and the same number of fatigue-related errors on duty (Figure 3).

Figure 2

Average Differences Between NWC and LCC Pilots (as far as available and comparable) of the ITF Study (ITF, 2002) are Represented by the Black Bars. The Mean Differences in Percent (%, column 4 of Table 3) Between NWC and LCC of Our Present Dataset are Represented with the Light Gray Bars



Note. The mean differences in percent (column 4 of Table 2) between NWC (column 2 of Table 2) minus LCC (column 3 of Table 2) of our present dataset are represented with the light gray bars.

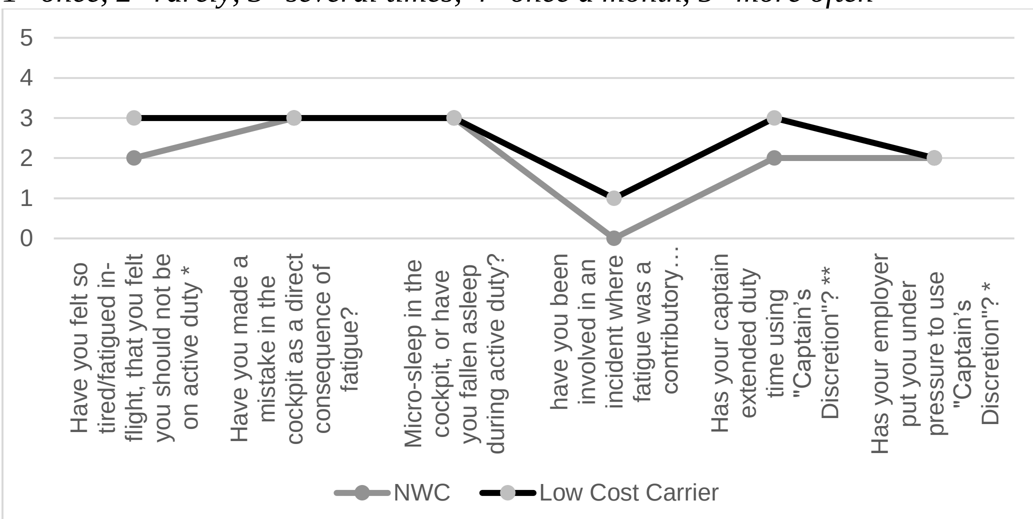
More LCC pilots reported being so tired or fatigued in-flight that they should not have been on active duty in the cockpit, or having to use commander's discretion (to extend the maximum legal duty hours beyond 13 or 14 h per flight duty period), a significant fatigue risk.

DOI: https://doi.org/10.15394/ijaaa.2022.1714

LCC pilots reported significantly more sleep problems (χ^2(2)=2.832; p=0.049). Multiple sleep problems in 8–14 nights per month were reported by 18.3% LCC pilots and 13.0% NWC pilots. 11.8% LCC versus 6.5% NWC and pilots reported considerable sleep problems in 15 or more nights/month (mean JSS item scores in Figure 4).

Figure 3

NWC and LCC pilots (N=338) Reporting Fatigue-Related Events Such as High Fatigue or Microsleeps in the Cockpit, Fatigue-Related Mistakes or Incidents, and Commander's Discretion. "How often in the last year have you …." 0=never, 1=once, 2=rarely, 3=several times; 4=once a month, 5=more often



Note. Mann–Whitney U tests for independent samples of NWC and LCC; * $p < 0.05$; ** $p < 0.01$

Significantly more LCC pilots reported severe fatigue (FSS 4-4.9: 45%) or excessive fatigue (FSS≥5) (χ^2 (2)=7.314; p=0.026). Of the NWC pilots, 40% reported severe fatigue (FSS 4–4.9), 30% excessive fatigue (FSS≥5). The mean FSS item scores of the actually healthy population of active airline pilots flying for NWC and LCC are displayed in Figure 5.

24.2% of LCC vs. 14.8% of NWC pilots reported significant symptoms of depression (χ^2 (1)=4.805; p=0.028), and overall, 19% reported positive depression screenings (PHQ8≥10). 7.1% NWC and 7.2% LCC pilots reported positive anxiety screening results (GAD7≥10), with no significant between-group differences (χ^2 (1)=0.001; p=0.976). The most frequently mentioned CMD symptoms were sleeping badly, being easily tired, and feeling tired all the time. The well-being of LCC pilots was slightly more impaired: Very low well-being (WHO5≤28) was reported by 14.4% of LCC and 9.8% NWC pilots. Low well-being (WHO5 29–50) was reported by 30.1% of LCC and 24.0% NWC pilots. Corresponding with high levels of fatigue, exhaustion, sleep deprivation, and sleep problems, pilots scored lowest on *"I have felt active and vigorous" and "I woke up feeling fresh and rested."*

Figure 4

Mean Item Scores (CI 95%) for FSS Items of NWC and LCC Pilots in this Study

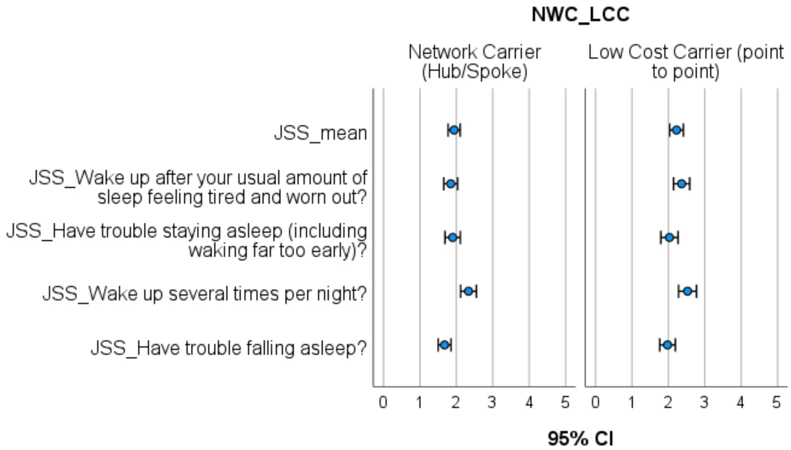
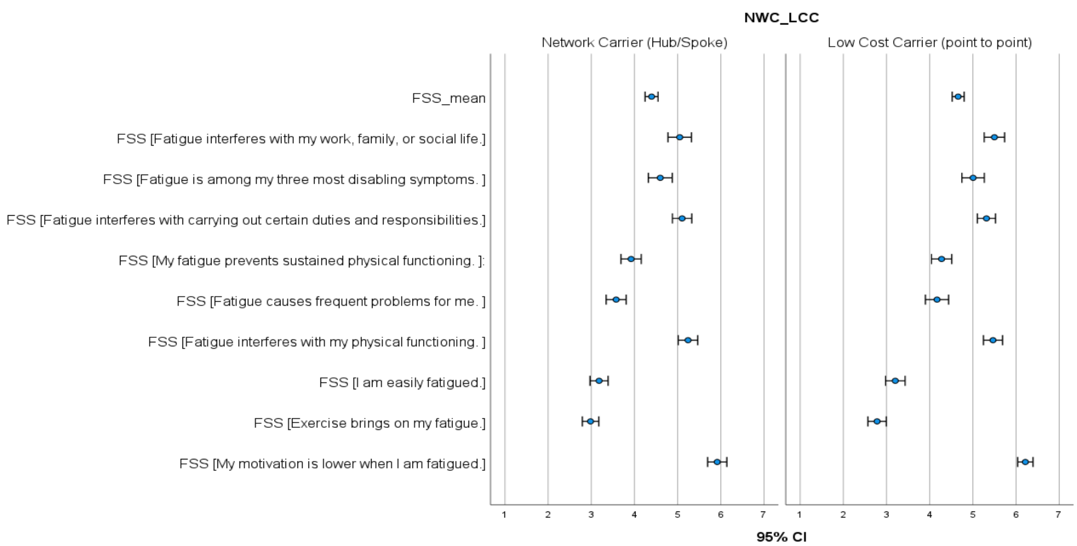


Figure 5

Mean Item Scores (CI 95%) for FSS Items of NWC and LCC Pilots in this Study



Discussion

LCC pilots reported significantly more demanding rosters, significantly higher fatigue, significantly more sleep problems, and significantly more mental health impairment, in line with previous research (ITF, 2002; Jackson & Earl, 2006). LCC pilots reported significantly more work-related stress like less experience, lower income, higher job-insecurity and more time pressure due to more sectors/month, more standby days, more early starts (associated with wake-up times between 3:00 and 4:00 a.m. and associated sleep restrictions), as well as significantly more depression symptoms and significantly lower well-being. When short- and long-haul pilots (Venus & grosse Holtforth, 2021b) or Australian and EASA-based pilots were compared (Venus & grosse Holtforth, 2022a), the differences between the groups were, on average, smaller regarding mental health issues, fatigue, and sleep difficulties. Short-haul pilots of LCC, flying for Australia based air operators are apparently most at risk for accumulated fatigue, burnout and finally mental health issues (Venus & grosse Holtforth, 2021b, 2022a). The Qualitative Content Analysis of pilots' open answers (Venus et al., 2022) provided valuable insights into how pilots experience interactions of stress, sleep, allostatic load and health, as previous studies had suggested (McEwen, 2006; McEwen & Karatsoreos, 2015; McEwen & Stellar, 1993; Venus & grosse Holtforth, 2021a; 2022b). In line with more health impairment, LCC pilots reported significantly more days off due to fatigue and sick-leave. These results suggest that LCC pilots are exposed to potentially harmful working conditions due to quantity of work, time pressure, more existential stress, and less resources (e.g., income, flight experience, job-security).

The impairment of LCC pilots' mental health and well-being is in line with previous research (Cahill et al., 2021; Cullen et al., 2020; Feijo et al., 2012; Jackson & Earl, 2006; Omholt et al., 2017; Venus & grosse Holtforth, 2021a). LCC pilots predominantly fly regional and/or short-haul operations, which are associated with a high workload, more take-offs and landings, more early starts, and thus more sleep restrictions and potential on-call flight duties on standby days (Honn et al., 2016; Roach et al., 2012; Vejvoda et al., 2014; Venus & grosse Holtforth, 2021b). High workload and stress levels were associated with higher fatigue and on-duty sleepiness (Reis et al., 2016b; Venus et al., 2022; Venus & grosse Holtforth, 2021a), and impaired health and well-being (Cahill et al., 2021; Cullen et al., 2020; Omholt et al., 2017)

Overall, most NWC and LCC pilots reported excessive ($FSS \geq 5$) or severe fatigue ($FSS \geq 4$). More than twice as many pilots reported severe or very high fatigue compared to the general population (Lerdal et al., 2005; Valko et al., 2008). These results are concerning because pilots should be less fatigued than the general population. Pilots are by law (ICAO, 2018) responsible for the lives and safe air transport of hundreds of passengers every day. In addition to that, more than twice as many pilots reported positive depression and anxiety screening results, compared with the general population (Kroenke et al., 2009; Spitzer et al., 2006). Pilots reported only moderate well-being on average (Krieger et al., 2014).

The differences between NWCs and LCCs have diminished as both operator types aim to maximize productivity (Aljurf et al., 2018; Reis et al., 2013; Venus et al., 2022). Therefore, the slightly more duty and flight hours might not solely be responsible for significantly more sleep problems and higher fatigue of LCC pilots. Today, especially short haul operating LCC pilots must cope with a multitude of stressors they often cannot control (like busy airspace, congested airports, drone encounters on short final, being blinded by laser-pointers, thunderstorms, etc.). These stressors and high time pressure could lead to more sleep problems and higher fatigue among LCC pilots. Little et al. (1990) described distinct negative consequences of high job insecurity on mental health, especially symptoms of depression and anxiety, which are usually associated with sleep problems. Fatigue, lack of sleep, work-related and psychosocial stress were reported to be significant risks to the physical and mental health of pilots (Venus & grosse Holtforth, 2021a, 2022b) and the general population (McEwen, 2004, 2006; McEwen & Karatsoreos, 2015; Sapolsky, 2004). In this study, 24.2%–44.5% of LCC pilots and 14.8%–34% of NWC pilots would require more thorough diagnostic testing for mental health issues, based on positive screening results.

Commission Regulation (EU) 2018/1042, medical requirements for flight crew licensing (e.g., Part-MED, 2019) and flight-time limitations (e.g., EASA FTL, 2014) explicitly link mental health and fatigue with flight safety. EASA does not allow pilots to fly when fatigued or otherwise not fit to fly. Higher workload, higher fatigue levels and more mental health issues can impair pilots' performance (O'Hagan et al., 2017, 2018, 2019; Venus et al., 2022) and flight safety (Bendak & Rashid, 2020; Bourgeois-Bougrine, 2020; Goode, 2003). Therefore, the health and safety of flight crews and passengers appear to be more at risk with LCC than with NWC. This conclusion is supported by the fact that the LCC pilots in this study actually reported significantly more fatigue-related incidents and accidents.

Limitations

The representativeness of the sample is difficult to determine. Only active pilots who were members of a European or Australian pilot union were able to participate. It is unknown how many pilots saw the online survey link embedded in union newsletters, along with other survey links. Due to the novelty of this topic and the exploratory nature of this study, and based on the multidimensional, comprehensive data set collected for all 338 active commercial pilots, the sample size appears to be nonetheless sufficient to yield important new insights. The sample size was limited due to a lack of funds. In addition, airlines and regulators were not interested in participating in or supporting the study. For a first explorative study, the quantity of data pertaining to pilots flying for different LCCs and NWCs seems acceptable. The assessment of potential differences between several LCCs and NWCs was beyond the focus of this research; it was considered more essential to collect individual pilots' actual rosters and working conditions and compare them for the groups of LCC and NWC pilots.

Data collection started in June 2018 and ended in March 2019, before the COVID-19 pandemic. Other obstacles might have made participation difficult: Pilot mental health issues, fatigue, and burnout are disqualifying factors for pilots as they jeopardize pilots' Medical Class 1 and career. Perhaps pilots who were less satisfied with their work might have felt more inclined to express their issues in a survey, whereas pilots suffering from fatigue might have felt less inclined to make the effort to participate.

The survey was quite long due to the complexity of the topic examined. The intention was to cover pilots' peak season with maximum duty and flight hours (i.e., pilots' summer flight plan in Europe and the time from Christmas until March in Australia). More pilots might have participated off-season. The sample size itself may not be a problem because a considerable amount of data was collected from each pilot. The investigated pilots were rostered for only 56%–66% of the legally allowed maximum of 190/200 duty and 100 flight hours per month, according to EASA's and similar FTL. Thus, pilots scheduled for maximum legal duty and flight hours may not have participated in this study . The sociodemographic data and results regarding fatigue, sleep problems, pilots' mental health and well-being are comparable with previous research (Aljurf et al., 2018; Cahill et al., 2021; Reis et al., 2016b; Williamson & Friswell, 2017; Wu et al., 2016). No other studies have reported lower fatigue levels and better mental health of pilots. Considering the guaranteed anonymity of this online survey, pilots should have answered honestly.

Since most LCCs only operate regional or short- or medium-haul operations, short-haul pilots may be overrepresented in the sample of LCC pilots. Previous research has found significant differences between short- and long-haul pilots (Honn et al., 2016; Jackson & Earl, 2006; Reis et al., 2016a; Venus & grosse Holtforth, 2021b). A possible interaction of the factors *type of operator* (LCC vs. NWC) and *type of operation* (short haul vs. long-haul operations) should be further investigated. Based on the available body of scientific evidence (as mentioned above and in Venus & grosse Holtforth, 2022a, b), Australian short-haul LCC pilots reported the greatest risk of accumulated fatigue and impaired health, while EASA-based LCC short-haul pilots are only slightly less at risk.

Regarding methodical limitations, the results of psychological questionnaires can be questioned, and they may be biased either purposely or by chance. Therefore, psychophysiological measurements of fatigue and recovery are required, combined with in-depth data regarding mental health. Sum scores of screening instruments obtained in self-assessment through online surveys are not diagnoses of mental disorders. Screening results require confirmation by standardized clinical psychological diagnosis. This is crucial, because what might seem to be a positive depression screening could be explained by excessive fatigue, associated with extremely impaired mood due to exhaustion and roster-related sleep deprivation. Interdisciplinary cooperation between aeromedical examiners and clinical and aviation psychologists is recommended to make evidence-based decisions in the case of pilot mental health issues, fitness to fly, and medical recertification.

Strengths

The survey assessed the individual pilot's perspective, referencing each pilot's schedules, experience, perceived stress, sleep problems, fatigue, mental health, and well-being. The study author is aware that more data could be included to capture the whole picture and to facilitate the comparison of LCCs and NWCs. However, in times of extreme competition and minimal profit margins, with NWCs trying to economically catch up with LCCs, it is almost impossible to obtain strategic rostering policies and applied settings for rostering software from either.

Undoubtedly, one strength of this study is the use of standardized questionnaires to assess pilots' workload, fatigue, sleep problems, mental health, and well-being, which have been used in previous research; most of these screening instruments have been recommended by the World Health Organization. Thus, the collected data were comparable with previous studies that also used instruments such as FSS, JSS, and PHQ9/8. Another strength concerns complex data acquisition, which does justice to the complexity of the topic better than previous, smaller studies.

Conclusions

Strategic decisions, detrimental competition and economic pressure have resulted in heavy workloads, increasing time constraints, more stress, and more demanding rosters, especially for LCC pilots. Although LCC pilots only reported slightly more duty and flight hours, LCC pilots reported more sleep problems, higher fatigue levels, more symptoms of depression, and lower well-being. These findings suggest that LCC pilots' stress could play an important role for sleep problems and fatigue. More existential stressors like high job insecurity, more time pressure, pressure from management to extend flight duties (commander's discretion), and fewer coping resources (e.g., less total flight experience, higher quantitative workload, more early starts and night flight duties, lower income, and poorer career opportunities), and working despite fatigue are affecting health and safety of LCC pilots. Short-haul pilots flying for LCCs are most at risk of accumulated fatigue and impaired health, Australian pilots are even more affected than EASA-based short-haul pilots of LCC.

In line with previous research, LCC pilots described a decay of safety culture, more fatigue related errors and incidents on flight duties. Differences in management and working conditions for flight crews at NWCs and LCCs have narrowed over time and will be further eroded by economic pressures. According to recent pilot feedback, NWC are now also scheduling their pilots for maximum legal duty and flight hours and minimum rest time, to catch up with the huge demand for post-Covid19 air travel, and to generate profits. Both groups of pilots raised concerns about flight-time limitations. Therefore, the airline industry, regulators and civil aviation authorities need to enforce substantially more restrictive flight time limitations. Otherwise, the already existing high fatigue, exhaustion and burnout as well as manifest health impairment cannot be compensated. The aviation industry must understand the difference between the symptom acute on-duty *"sleepiness"* and the complex psychophysiological construct of *"fatigue."* The traditional fragmented view of fatigue is insufficient, and not supported by scientific evidence. The role of stress for sleep, fatigue and health issues needs further investigation. Pilots must not fly, if they are unfit due to high levels of fatigue, physical or mental health problems in order to keep flight operations safe.

Acknowledgments

We would like to thank Alvarez IT Solutions for programming the online survey, IT security, and web hosting. My sincere thanks go to my dedicated, informal network of highly experienced and academic pilots. Their professional support and valuable background information have contributed to the quality of this research.

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Declaration of interest: none.

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Appendix 1

Overview of the Most Basic Flight Time Limitations (FTL) of the European Aviation Safety Agency (EASA), Civil Aviation Safety Authority (CASA), and Federal Aviation Administration (FAA) in Effect at the Time of Data Collection from June 2018 to March 2019 (Venus & grosse Holtforth, 2021a). All Definitions from EASA FTL (2014, p. 21)

Flight Time Limitations in Effect until March 2019				
		EASA FTL: ORO.FTL.210	**CASA FTL 48.1**	**FAA Part 121**
Duty period or duty hours*/pilot (multi-pilot operation)	Max. duty hours	13 duty hours	14 duty hours	14 duty hours
	Max. duty hours/month	190 duty hours	200 duty hours	
	Commander's discretion** (Extension of max. duty hours)	max. 13 duty hours (plus max. 2 duty hours)	max. 14 duty hours (plus max. 1 duty hour)	max. 14 duty hours (plus max. 2 duty hours)
Augmented Crews§	Depending on time of day	FDP > 9–13 duty hours	FDP > 8–14 duty hours	FDP > 9–14 duty hours
Flight hours†**/pilot** (multi -pilot operation)	In any 28 consecutive days	100 flight hours	100 flight hours	100 flight hours
	In any calendar year	900 flight hours		1,000 flight hours
	In any 12 consec. months	1,000 flight hours	1,000 flight hours	
Minimum rest‡	Before flight duty	10 hours (exceptions)	10 hours (exceptions)	10 hours

Note. FDP = flight duty period

* "Duty period' [duty hours] means a period which starts when a crew member is required by an operator to report for or to commence a duty and ends when that person is free of all duties, including post-flight duty" (EASA FTL, 2014, p. 21).

** "Commander's discretion may be used to modify the limits on the maximum daily FDP (basic or with extension due to in-flight rest), duty, and rest periods in the case of unforeseen circumstances in flight operations beyond the operator's control, which start at or after the reporting time" (EASA FTL, 2014, p. 21).

§ "Augmented flight crew' means a flight crew which comprises more than the minimum number required to operate the aircraft, allowing each flight crew member to leave the assigned post, for the purpose of in-flight rest, and to be replaced by another appropriately qualified flight crew member" (EASA FTL, 2014, p. 21).

† "Flight time' [flight hours] means the time between an aircraft first moving from its parking place for the purpose of taking off until it comes to rest on the designated parking position and all engines or propellers are shut down" (EASA FTL, 2014, p. 21).

‡ "Rest period' means a continuous, uninterrupted, and defined period of time following duty or prior to duty, during which a crew member is free of all duties, standby, and reserve" (EASA FTL, 2014, p. 21).

Appendix 2

WHO5 Well-Being Index

1. I have felt cheerful and in good spirits
2. I have felt calm and relaxed

SRQ 20 Self Reporting questionnaire for Common mental disorders

1. Do you often have headaches?

3. I have felt active and vigorous
4. I woke up feeling fresh and rested
5. My daily life has been filled with things that interest me

PHQ8: Depression Screening
1. Little interest or pleasure in doing things
2. Feeling down, depressed, or hopeless
3. Trouble falling or staying asleep or sleeping too much
4. Feeling tired or having little energy
5. Poor appetite or overeating
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down
7. Trouble concentrating on things, such as reading the newspaper or watching television
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual

GAD 7: Generalized Anxiety Screening
1. Feeling nervous, anxious or on edge
2. Not being able to stop or control worrying
3. Worrying too much about different things
4. Trouble relaxing
5. Being so restless that it is hard to sit still
6. Becoming easily annoyed or irritable
7. Feeling afraid as if something awful might happen

PHQ Stress
1. Worries about your health
2. Your weight or your look/appearance
3. Little or no sexual desire or pleasure in

2. Is your appetite poor?
3. Do you sleep badly?
4. Are you easily frightened?
5. Do your hands shake?
6. Do you feel nervous, tense, or worried?
7. Is your digestion poor?
8. Do you have trouble thinking clearly?
9. Do you feel unhappy?
10. Do you cry more than usual?
11. Do you find it difficult to enjoy your daily activities?
12. Do you find it difficult to make decisions?
13. Is your daily work suffering?
14. Are you unable to play a useful part in life?
15. Have you lost interest in things?
16. Do you feel that you are a worthless person?
17. Has the thought of ending your life been on your mind
18. Do you feel tired all the time?
19. Are you easily tired
20. Do you have uncomfortable feelings in your stomach?

JSS Jenkins Sleep Scale
How often in the past four weeks did you …
1. have trouble falling asleep?
2. wake up several times per night?
3. have trouble staying asleep? (including waking far too early)
4. wake up after your usual amount of sleep feeling tired and worn out?

FSS Fatigue Severity Scale
1. My motivation is lower when I am fatigued.
2. Exercise brings on my fatigue.

sexual intercourse 4. Difficulties with your spouse, partner, or friend 5. Burden of caring for children, parents, or other relatives 6. Stress at work or at school 7. Financial problems or worries 8. To have nobody to talk about problems 9. Something bad that happened recently 10. Thoughts of scary events of the past or dreams about them	3. I am easily fatigued. 4. Fatigue interferes with my physical functioning. 5. Fatigue causes frequent problems for me. 6. My fatigue prevents sustained physical functioning. 7. Fatigue interferes with carrying out certain duties and responsibilities. 8. Fatigue is among my three most disabling symptoms. 9. Fatigue interferes with my work, family, or social life.

DOI: https://doi.org/10.15394/ijaaa.2022.1714