Pilot Mental Health, Negative Life Events, and Improving Safety with Peer Support and a Just Culture

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BACKGROUND: In the last 35 yr, 17 commercial aviation accidents and incidents, with 576 fatalities, could likely have been attributed to mental disease of a pilot. Screening tools for mental health risks in airline pilots are needed. There is growing interest in pilot peer-support programs and how to incorporate them in a just culture, meaning that pilots can report mental health complaints without a risk of job or income loss. We combined findings from aviation accidents and incidents with a search of scientific literature to provide data-based recommendations for screening, peer-support, and a just culture approach to mental health problems.

METHODS: Commercial aviation accidents and incidents in which a mental disorder of a pilot was thought to play a role were reviewed. Subsequently, PubMed and PsychInfo literature searches were performed on peer-support programs, just culture human resource management, and the risk of negative life events on developing suicidal ideation and behavior in comparable professional groups.

RESULTS: Lethal accidents were mostly related to impaired coping with negative life events. Negative life events are clearly related to suicidal thoughts, attempts, and completed suicide. A protective effect of peer-support programs on mental health problems has not been established, although peer-support programs are generally appreciated by those involved. We did not find relevant literature on just culture.

DISCUSSION: Negative life events are likely a useful screening tool for mental health risks. There is still a lack of evidence on how peer-support groups should be designed and how management of mental health risks can be implemented in a just culture.

KEYWORDS: mental health, negative life events, peer-support, just culture.

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Mental health problems of flight crewmembers are a serious threat to aviation safety. A horrifying example is the Germanwings flight 9525 crash in March 2015, when the copilot purposely crashed his aircraft. He had suffered several depressive episodes and he had received mental healthcare treatment multiple times.[13]

There will likely never be a completely reliable method to identify which pilots are at risk for mental health problems, because screening for mental disorders comes with a lot of difficulties. For example, it is unknown which risk factors for mental health problems and suicidal behavior are most relevant to the airline pilot population and, also, pilots tend to fill in psychological test questions as favorably as possible.[10,11,15]

After the Germanwings accident, there is an increased concern about the risk to aviation safety that mental disorders of airline pilots may cause. This concern is shared both by the general public and by aviation authorities. The European Aviation Safety Agency has implemented several new recommendations that should prevent this kind of accident. Where possible, measures should be incorporated into airline safety management systems and they should always comply with just culture principles.[26] Just culture was originally developed in the field of accident and safety investigations. Its goal was to increase safety after an accident or serious incident had happened. Historically, if an accident had happened, the subsequent investigation aimed to find people who could be held responsible. Those

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people were then punished. However, in the mid-twentieth century, safety investigations became an area of scientific research and scientists discovered that most accidents were caused by so-called 'system errors', not by individual misconduct. Human errors that lead to accidents were discovered to mainly result from flaws in the way work was organized. Methods were developed to learn from accidents in order to prevent them from happening again. The so-called 'blame-free' approach ensured that people could report mistakes, incidents, and accidents without risk of punishment. However, many found it unjust that people who were grossly negligent or performed willful misconduct could be immune to any sanctioning. As a solution, just culture was developed. In a just culture, people are not punished for errors as long as they performed to their best effort. However, punitive measures are taken in cases of gross negligence or willful misconduct. Just culture has been widely accepted in the aviation industry, healthcare, and other high-risk industries.[23,62]

In the recommendations made after the Germanwings crash, it was stated that all measures should be in accordance with just culture principles, but it was not specified how this should be done.[26] Its wide acceptance in the aviation industry makes just culture highly useful in reducing the stigma that is associated with pilot mental health problems. In our opinion, a just culture approach to mental health risks should mean that pilots have to report mental health complaints, but they should be able to do so without a risk of job or income loss.

Despite medical and psychological screening, pilots are at risk for experiencing mental distress, which may impair their performance and jeopardize safety. Kenedi et al.[41] studied suicide and murder-suicide involving aircraft. No single factor was associated with the risk for suicide or homicide-suicide; however, factors associated with both events included legal and financial crises, occupational conflict, mental illness, and relationship stressors. Kenedi et al. studied both acts perpetrated by pilots and by passengers, and included both commercial and general aviation incidents, making their results less comparable to the commercial airline pilot population.[41] A recent study by Wu et al. showed that 13.5% of questioned commercial airline pilots met the depression threshold on the PHQ-9 questionnaire; 4.1% of the pilots reported having suicidal thoughts in the last 2 wk.[64] Attention to mental health risks in flight crews is of paramount importance and an important research goal is to identify risk factors for suicidal behavior in the airline pilot population. In aviation personnel, specific risk factors for mental health problems could be job-related stress (heavy workload, irregular working hours, performance checks), family stress (being far away from home, family health issues, lack of social support), and negative life events (divorce, financial problems, loss of work) and lack of physical activity.[9,21,28]

In the majority of aircraft accidents due to mental health problems, negative life events played a substantial role, especially in fatal accidents. Negative life events are events that are accompanied by notable changes in a person's life. The most frequently occurring negative life events leading to suicide are: work problems, family discord, somatic illness, financial problems, unemployment, separation, and interpersonal loss.[30,42]

Negative life events are a known risk factor for mental health problems and suicidal behavior in the general population. It is unknown whether this is also the case for the highly selected and educated group of airline pilots. Negative life events may be a useful screening tool for mental health risks in this population. No specialist mental examination is required to confirm whether a negative life event happened. Furthermore, experiencing a negative life event is less stigmatized in comparison to suffering from a mental disorder. Whereas mental complaints are often considered 'weakness,' negative life events are mostly felt to be something bad, but external, happening to people. This is beneficial because most pilots are unwilling to seek help due to fear of the possible work consequences and the stigma attached to a mental disorder or to suicidal thoughts.[11] For these reasons, negative life events can be well incorporated into peer-support programs. Also, whether a negative life event happened can be discovered without a formal mental health examination. As it does not depend on a subjective assessment, concern with negative life events fits excellently into just culture principles. Although negative life events are a risk factor for mental disorders, most people will experience them without developing a mental disorder. Negative life events may cause mental disorders only in the case of coping difficulties. Nevertheless, as there is no scientific evidence for systematically screening all aviation personnel for the presence of mental disorders, discussing negative life events during medical evaluations may be a good starting point.[50] It might also be meaningful to provide (peer) support for aviation personnel who have experienced a negative life event in order to decrease the risk of mental health problems.

It is currently unknown, however, to what extent peer-support programs protect against mental health problems in the airline pilot population, and what their optimal design is, especially for helping pilots to deal with negative life events. It is also unknown how just culture principles can help to reduce mental health risks. It is important to establish evidence-based tools for daily clinical practice that assist physicians in assessing mental health risks. We chose not to study the effects of alcohol and drug use, as they were not related to the incidents and accidents caused by mental health problems that we found. Also, several studies have already addressed the risk of substance abuse to aviation safety.[16,20,43]

Instead, we aimed to study whether negative life events are a risk factor for mental health risks in the highly selected population of airline pilots. We also studied how peer-support groups and just culture principles can be applied to pilot mental health problems in general, and to negative life events in particular.

METHODS

No approval from an ethical review committee was needed as this was a literature study. Where applicable, PRISMA guidelines were followed.[49] The design of this study is depicted in **Fig. 1**.

As information on aviation accidents is not reported in traditional medical literature, a Google Web Search was performed

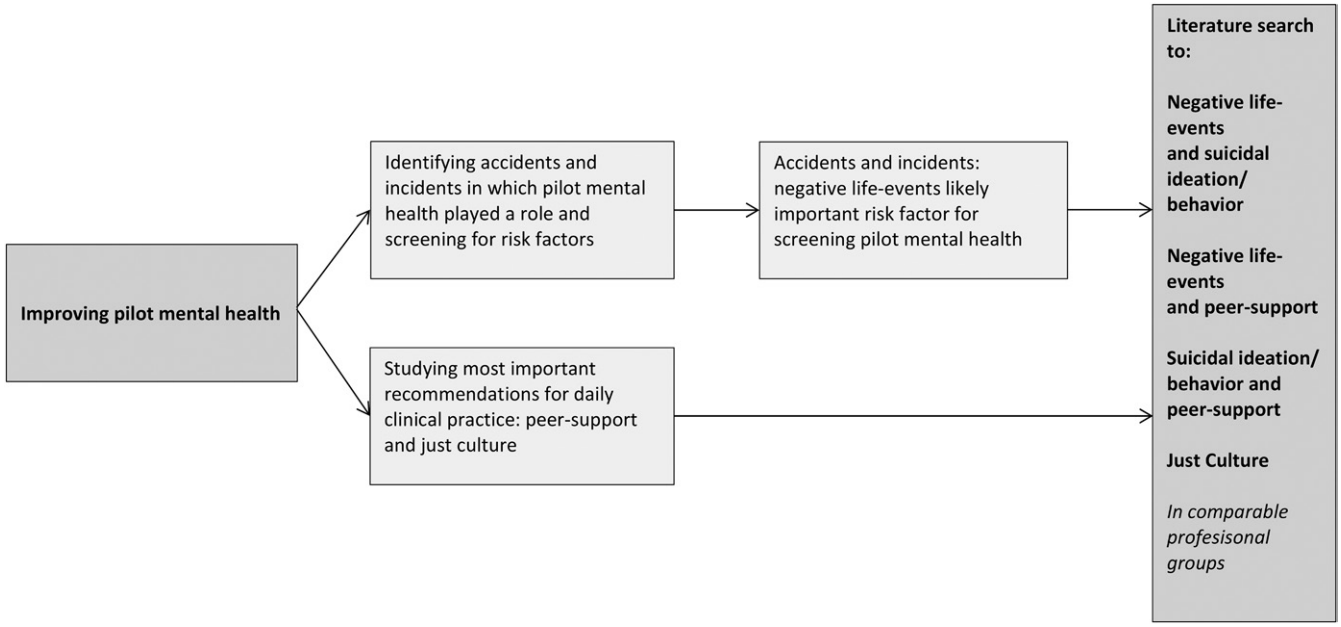

Fig. 1. Study design.

on the terms "pilot suicide aircraft," "pilot psychosis aircraft," and "pilot mental health." We analyzed official resources such as accident reports, but also reports in popular media. Incidents and accidents were only studied if either the official investigation report had judged deliberate actions of a pilot as the most likely cause of the incident or accident, or one or more of the investigating organizations had concluded this.

A literature search on the risk of negative life events on developing suicidal ideation and behavior, peer-support programs, and just culture human resource management was conducted using Medline and PsychInfo databases. All results were screened manually for references to other relevant articles.

Their selection makes airline pilots incomparable to the general population, so findings obtained in the general population cannot be applied directly to the specific population of airline pilots. As no specific research on the risk of negative life events in the airline pilot population has been published, we analyzed data in professional groups with comparable skill levels using criteria developed by the International Labor Association.[38] The International Standard Classification of Occupations (ISCO) identifies four skill levels of occupation. Occupations with skill level 3 or 4 were chosen for this study, because these were comparable with the occupational skill level of airline pilots.

ISCO does not group military populations under a specific skill level. However, military populations are in most cases screened physically and psychologically prior to joining the forces, which makes them different from the general population, and better comparable to the airline pilot population. We therefore also included studies in military populations.

We did not include airline pilots in the search strategy because this would have led to the loss of many relevant articles. All searches are up to date as per March 1, 2017.

RESULTS

We found 17 accidents and incidents in which a mental disorder of a pilot was thought to play a role. The characteristics of these are depicted in **Table I**. There were 9 lethal accidents causing 576 fatalities in total. We chose to apply the strictly neutral terms accident and incident in order not to make any interpretations beforehand to present the data in the most objective way possible.

In four cases, a pilot developed an acute psychosis. In the Japan Airlines crash in 1983, the captain purposely crashed his DC-8 into shallow water; 24 people died in this crash. The captain had been grounded for 3 wk for "psychosomatic illness" in 1980. Afterwards, he had shown odd behavior, with symptoms of impaired reality testing. It appears that he had suffered from a psychotic episode during the crash. He was prosecuted, but found not guilty due to insanity.[3,39]

We found three more incidents in which a pilot suffered psychotic symptoms during the flight. Fortunately, in these cases, the other pilot could take over the controls and make a safe landing. In one case, the copilot suffered acute mental distress. He had to be removed from the cockpit and to be restrained in a passenger seat by his fellow crewmembers. According to passenger reports, the copilot was crying, shouting, and talking to God while having a confused and disoriented appearance. After having been removed from the aircraft, he was taken to a psychiatric hospital.[50] In another sparsely documented incident, the copilot showed such disturbed behavior that he had to be restrained in a passenger seat by fellow crewmembers.[37,51]

Minutes after takeoff, a JetBlue captain stated to his copilot that they would not make it to Las Vegas. Later on, he marched through the cabin, spoke about Al Quaida and the 9/11 attacks, and claimed that a bomb was present on board the aircraft.

Table I. Incidents and Accidents Related to Pilot Mental Health Problems.

FLIGHT/DATE/REFERENCE	FATALITIES	SHORT DESCRIPTION	MENTAL CONDITION/NEGATIVE LIFE EVENTS
Japan Airlines 350 (1982)[3,39]	24	Deliberate crash	Psychosis
FedEx 705 (1994)[61]	-	Hijack and attempted crash	Facing termination of employment
Royal Air Maroc 630 (1994)[25,34]	44	Most likely deliberate crash	No mental illness known, lovers quarrel in popular media
British Airways (1996)[13]	-	Panic attack	Panic/anxiety disorder
Silk Air 185 (1997)[24]	104	Deliberate crash most likely	Financial losses, disciplinary actions from airline for violating company regulations
Air Botswana (1999)[4]	1	Deliberate crash	Declared unfit for duty due to medical reasons
EgyptAir 990 (1999)[45,63]	217	Deliberate crash	In popular media, report that the first officer had been demoted a few hours before the flight
Galaxy Air Cargo (2001)[46]	2	Collision with mountain	Previous imprisonment for cocaine distribution, first officer's medical considered for denial, use of cocaine by captain, and antidepressants by first officer
Air Canada 848 (2008)[50]	-	Acute mental distress of copilot	Acute psychosis
JetBlue 191 (2012)[22,50]	-	Captain became severely confused	Acute psychosis
St. George Municipal Airport (2012)[5,18]	1	Attempted stealing of aircraft and subsequent suicide	Accusation of murder
LAM Mozambique 470 (2013)[44]	33	Deliberate crash	Loss of son and marital problems
Air Canada 584 (2013)[37,51]	-	Copilot suffered acute mental distress	Most likely acute psychosis
Alitalia (2015)[2,35,56]	-	Pilot threatened to crash his aircraft	Marital problems
Condor 7438 (2015)[1,31]	-	Panic attack	Most likely anxiety disorder
Germanwings 9525 (2015)[13]	150	Deliberate crash	Depressive disorder, problems with vision, relationship problems
United Airlines (2017)[19,57]	-	Acute mental distress	Most likely coping problems after divorce, formal diagnosis of a mental disorder is not known

He had to be locked out from the cockpit and restrained in the passenger cabin by fellow crewmembers and passengers. Prior to this incident, he had suffered serious sleep difficulties. After an emergency landing he was admitted to a psychiatric hospital.[22,50]

In two cases, a pilot suffered an anxiety attack. These incidents did not lead to casualties, as the other pilot could take over the controls and land the aircraft safely. They are only sparsely documented. In one accident, the first officer complained of feeling unwell and said he was frightened of altitude. Eventually, he had to be restrained in the passenger cabin and the aircraft had to divert. Later, it was discovered that the first officer had suffered anxiety attacks before and he admitted to having taken psychotropic medication without declaring it to the aeromedical authorities.[13] In the other incident, the copilot became incapacitated in flight, forcing the captain to divert the aircraft and make an emergency landing.[1,31]

In only one accident, the use of antidepressants and psychoactive substances was thought to play a role. A DC-3 departed at night using visual flight rules without filing a flight plan and collided with a mountain shortly after takeoff. The captain had previously been imprisoned for cocaine distribution. A toxicological examination of the captain found cocaine and metabolites of cocaine in his blood. Previously, the first officer had experienced an episode of loss of consciousness, and her medical certificate had been denied. However, after appeal, she had obtained a second-class medical certificate. A toxicological examination of the first officer found two different prescription antidepressant drugs in her blood. However, a diagnosis of mental illness at the time of the accident is not known.[46]

A formal diagnosis of a depressive disorder had only been made in the Germanwings accident. The copilot had suffered several depressive episodes and he was also suffering a depressive disorder and medically unexplained visual problems at the time of the accident. The antidepressants citalopram and mirtazapine and the sleeping aid zopiclone were detected in his blood.[13]

In all incidents and accidents in which no diagnosis of a mental disorder had been made, the pilot involved had been confronted with one or more negative life events. A flight engineer tried to hijack FedEx flight 705 to let it crash on the FedEx headquarters. He had been accused of irregularities in reporting his flight hours and he was facing termination of his employment. Prior to the accident, he had rearranged his financial affairs.[61]

A lovers' quarrel was thought to play a role in the deliberate crash of Royal Air Maroc flight 630. However, this was only speculated on in popular media and not in the official report.[25,34]

In the Silk Air crash, the U.S. National Transport Safety Board (NTSB) concluded that this crash was most likely the result of deliberate manipulation of the flight controls by the captain. However, the Indonesian authorities disputed this. The captain suffered substantial financial losses due to share trading. He had received disciplinary actions from the airline for violating company regulations. The event took place exactly on the date he had lost three squadron mates in an accident 18 yr earlier.[24]

After having been declared unfit to fly, an Air Botswana pilot stole an empty aircraft and deliberately crashed it. The pilot had been declared unfit for duty due to medical reasons, which could endanger his flying career. An exact diagnosis of mental illness is not known, but he had repeatedly made suicidal threats to airport authorities.[4]

According to the NTSB, the crash of EgyptAir flight 990 into the Atlantic Ocean was the result of deliberate flight control inputs by the copilot. The report by the Egyptian authorities disputed this and states mechanical failure as the most probable cause.[45] In several popular media, however, it has been suggested that the Egyptian conclusion was politically driven. No mental illness of the copilot has been known and the NTSB report does not speculate on the intentions that may have driven him. However, some years after the crash a former EgyptAir pilot claimed that the first officer had been reprimanded several times for inappropriate sexual behavior, and that he had been demoted by a high EgyptAir official flying as a passenger on the plane just a few hours before the flight departed.[63]

In the St. George Municipal Airport Incident, a commercial airline pilot who had been accused of murdering his former girlfriend tried to steal a CRJ-200 aircraft from his employer in order to escape. However, during taxiing, he hit a jetbridge and ran off the tarmac. When police officers subsequently entered the aircraft (with the engines still running), he shot himself to death. The pilot had not been diagnosed with a mental illness, but was sent on leave by his employer at the time of the incident.[5,18] The crash of LAM Mozambique Airlines flight 470 was caused by the deliberate actions of the captain, who first locked the first officer out of the cockpit and then manually disengaged the autopilot settings, making the aircraft crash. He did not have a diagnosis of a mental disorder. Various reports state, however, that the captain lost his son to a car accident 1 yr prior to the accident, that his daughter had undergone extensive heart surgery, and that he suffered problems from the unresolved divorce process from his first wife.[44] An Alitalia Boeing 777 had to be halted by police officials minutes before departing, after the pilot, who was facing marital problems, sent a text message to his wife that he was going to crash his aircraft. She immediately informed the police, who arrested the pilot.[2,35,56]

Also in the Germanwings accident, the copilot feared losing his pilots' license because of his medical problems.[13] Recently, the captain of a United Airlines flight boarded her airplane in street clothes. She then started ranting about her recent divorce and the presidential elections a few months earlier. She had to be removed from the aircraft and was replaced by another crew. A formal diagnosis of a mental disorder is not known.[19,57]

We subsequently performed a Medline search for the risk of negative life events (see **Fig. 2**). The 13 studies we discovered described medical students and physicians ($N = 4$), veterinarians ($N = 1$), and military ($N = 8$). An overview of these studies is depicted in **Table II**.

Tyssen et al. performed three studies on medical students and physicians in the same Norwegian cohort. The authors found that negative life events were associated with mental health complaints, suicidal thoughts, and suicide attempts. The negative life events leading to this were relationship and marital problems, legal problems, and work stress. Apart from negative life events, not being married, previous mental health problems, and personality problems were related to suicidal ideation and behavior.[58–60]

Fink-Miller tested the relationship between medicine-related life events, such as witnessing a patient's death or giving someone a life-limiting diagnosis, and acquired capability for suicide. Both provocative experiences inside and outside of work were related to an increased acquired capability for suicide.[29]

Platt et al. interviewed 21 veterinarians. Risk factors for suicidality were: workplace relationships, career concerns, patient issues, number of hours and volume of work, and responsibility. Two-third of participants reported co-occurring difficult life events (most common: family or relationship problems related to work).[48]

Thoresen et al. studied Norwegian veterans returning from peacekeeping service and found that negative life events were related to suicide. Risk factors that contributed to an increased number of suicides and suicidal ideation were: divorce, living alone, negative family background factors, negative life events, and low levels of social support.[54,55]

In a military research project by Belik et al., interviews that provided a comprehensive examination of mental disorders, health, and well-being were held with 8441 Canadian military. Sexual and other interpersonal traumas (for example: rape, sexual assault, spousal abuse, child abuse) were significantly associated with suicide attempts in both men and women.[7]

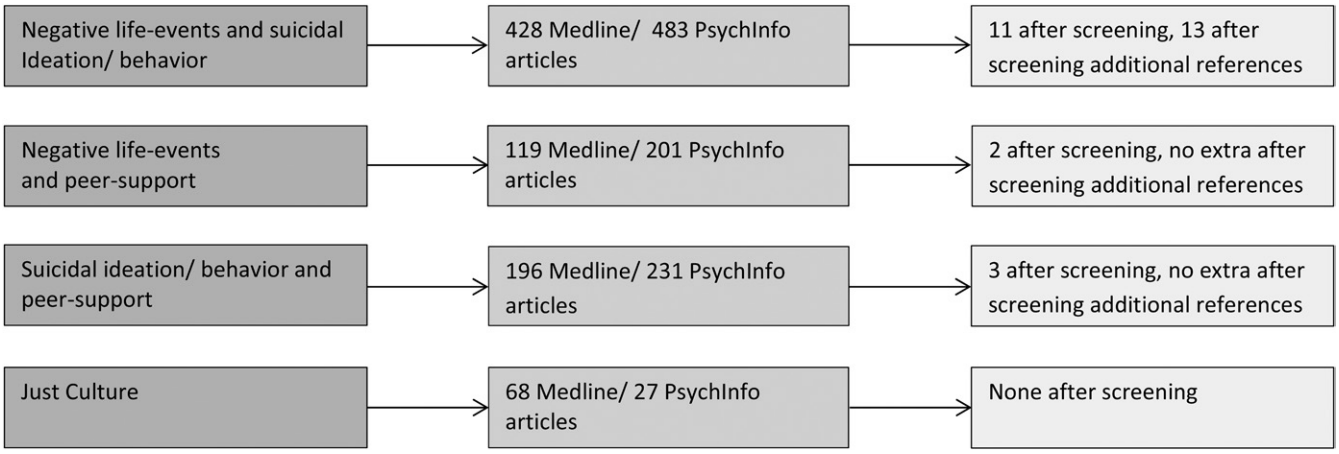

Fig. 2. Results of the literature searches.

Table II. Literature on the Risk of Negative Life Events on Developing Suicidal Ideation and/ or Behavior in Comparable Professional Groups.

STUDY	DESIGN	POPULATION	OUTCOME
Tyssen (2000)[59]	Prospective questionnaire study	Medical students ($N = 522$)	Significant predictors for mental health problems: life events in previous year (divorce, death of family member, serious law violation, relationship problems).*
Tyssen (2001)[60]	Prospective questionnaire study	Medical students ($N = 522$)	Predictors of suicidal thoughts and suicidal planning: not married,* life events (violation of law and relationship problems, working hours, job stress).*
Tyssen (2004)[58]	Prospective questionnaire study	Medical students ($N = 439$)	Predictors of suicidal planning: negative life events (divorce, problems with partner, moved away from parents, severe depressive symptoms).* Predictors of transition from suicidal thoughts to suicidal planning: reality weakness*, depressive symptoms.*
Thoresen (2006)[55]	Interview study	43 peacekeepers who committed suicide	28% of the suicides experienced a negative life event before peacekeeping,* 30% a negative life-event after peacekeeping. 77% were unmarried or divorced.*
Pettit (2006)[47]	Cohort study	298 young military	An association between negative life events and suicide attempt was found.*
Thoresen (2008)[54]	Follow-up questionnaires	300 repatriated peacekeepers	Risk factors for suicidal ideation were: living alone,* negative life events,* and low levels of social support.
Belik (2009)[7]	Interview study	8441 active military	Sexual and other interpersonal traumas were associated with suicide attempts.*
Black (2011)[8]	Retrospective cohort study	Army soldiers suicide cases ($N = 874$)	79% had personal stressors: relationship problems, military or work-related stress, physical health problems. 31% had a history of legal problems. 33% had negative life events from childhood or other periods prior to entering the army. No control group was present to establish significance.
Bryan (2012)[12]	Follow-up study	72 active duty U.S. soldiers reporting suicide attempt in the past month	In 28% a negative event that could have triggered the suicide attempt was reported.* External events and emotional experiences occurring in the 24 h before suicide attempts were associated with higher levels of suicidal intent.*
Platt (2012)[48]	Semistructured interviews	21 veterinarians with attempted suicide or suicidal ideation	Contributory factors: workplace relationships, career concerns, patient issues, number of hours and volume of work, and responsibility. Two-third of participants reported co-occurring difficult life events (most common: family or relationship problems). No control group was present to establish significance.
Gradus (2013)[32]	10-yr follow-up study	U.S. marines ($N = 680$)	Childhood sexual abuse, sexual assault, emotional and physical neglect had a significant association with suicide.* 50% of the participants who died by suicide had experienced one or more significant life stressor.
Fink- Miller (2015)[29]	Electronic questionnaires	376 physicians	Work experiences common to physicians predicted acquired capability for suicide.*
Shen (2016)[52]	Cohort study	All U.S. military between 2001–2011 ($N = 3,3795,823$)	Stressful life events (divorce and demotion) associated with increased hazard of suicide.*

* Finding reported to be statistically significant by the authors.

Black et al. performed a retrospective cohort study using database information on 874 suicide cases of Army soldiers from 2001 to 2009. Of the suicide cases, 79% had personal stressors: relationship problems, military work-related stress, or physical health problems. There were 31% who had a history of legal problems and 33% had evidence of contributing negative life events from childhood or other time periods prior to entering the army.[8]

A follow-up study by Bryan et al. studied 72 soldiers referred for outpatient care after admission due to suicide risk. In 28% of the cases, an important negative event that could have triggered the suicide attempt was reported. External events and emotional experiences occurring in the 24 h before suicide attempts were associated with higher levels of suicidal intent.[12]

Gradus et al. performed a 10-yr follow-up study from the start of recruit training of U.S. Marines ($N = 680$) and a subsample of them who had completed suicide ($N = 6$) during the follow-up period. Marines who experienced one or more life stressors prior to the recruit training had a 3.9 times higher odds ratio of suicide attempt. Childhood sexual abuse, sexual assault, and childhood emotional and physical neglect had a significant association with suicide. Of the participants who died by suicide, 50% had experienced one or more significant life stressors.[32]

Pettit et al. examined if the presence of a very early onset bipolar disorder moderated the relationship between negative life events and suicidality. In those not diagnosed with very early onset bipolar disorder, an independent association between negative life events and suicide attempts was found.[47]

Shen et al. studied all suicides in U.S. military personnel between 2001–2011. They found that a diagnosis of self-inflicted injury or mental disease, a history of law violations, and stressful life events (divorce and demotion) were significantly associated with an increased hazard of suicide.[52]

We then searched for evidence of a protective effect of peer support for professionals encountering negative life events (Fig. 2). In total, we found five articles about the effect of peer support in professional populations that were comparable to airline pilots (**Table III**).

Three articles (Hochberg et al., Castellano, and Greden et al.) discussed programs for peer support in order to mitigate mental health risks.[17,33,36] One study focused on surgical residents, one was performed in a Medicine and Dentistry faculty, and one in the military. The authors were generally positive regarding the effects of peer support, but did not provide empirical evidence to support this.

Burnard et al. reported mental health stressors and coping strategies of community mental health nurses in Wales. Effective coping strategies were peer-support groups, personal strategies, and receiving clinical supervision.[14] Beehler et al. provided a direct comparison between mental health recovery groups led by clinicians vs. mental health recovery groups led by peers. Participants experienced both peer and clinician facilitated support as helpful. Peer supporters were especially helpful in giving perspective on participants' experiences, beliefs, and thoughts. Clinicians drew on professional expertise as well as on life experiences that were lacking in patients.[6]

Finally, we searched for studies on how mental health risks or negative life events can be incorporated into just culture safety management (Fig. 2). However, we did not find any relevant articles.

DISCUSSION

Tens of thousands of pilots carrying millions of passengers may be affected by mental health problems, and it is of the utmost importance that mental health screening and support, where possible, are based on scientific clinical evidence. We analyzed commercial aviation incidents and accidents in which a mental disorder of a pilot was thought to play a role. We subsequently studied scientific literature on the risk of negative life events, peer support, and just culture in relation to suicidal ideation and behavior in comparable professional groups. Our main finding is that negative life events seem to be related to mental health risks in the highly selected and educated population of airline pilots. Especially relationship difficulties and divorce, as well as job, legal, and financial problems, seem to be significant. Therefore, when screening pilots for mental health risks, it is important to pay attention to recent negative life events. Also, peer support programs seem to be useful in mitigating mental

Table III. Literature on Peer-Support in Comparable Professional Groups.

STUDY	DESIGN	POPULATION	OUTCOME
Hochberg et al. (2013)[36]	Studying an interactive seminar to assess knowledge of signs of stress, depression, and suicidal ideation in colleagues.	21 surgical residents.	Educating house staff about depression, divorce, suicide, and substance abuse is crucial to prevent its associated consequences.
Castellano (2012)[17]	Narrative review to describe peer-support programs.	Peer-support programs for cops, veterinarians, and emergency workers.	Both peers and mental health professionals should be involved in peer support programs. The programs have offered healing, support, and solidarity.
Greden et al. (2010)[33]	Survey tool to understand the scope of veterans' problems and mental health needs and development of Buddy-to-Buddy concepts.	926 returning Michigan Army National Guard's soldiers and spouses, of which 40% screened positive for a mental health problem.	Buddy-to-Buddy would help to address many untreated individuals; improve entry into and adherence to treatment; accelerate clinical improvements by enabling exposure to effective treatments for PTSD, depression, and other risk variables; and reducing suicides for returning veterans.
Burnard et al. (2000)[14]	Questionnaire study to identify what caused the most stress and identify factors that help to cope with stress.	614 qualified Community Mental Health Nurses (CMHN), with 301 responders (49%).	Stressors: perceived workload, excessive paperwork, and administration and client-related issues. Coping strategies: peer support groups, personal strategies, and receiving clinical supervision.
Beehler et al. (2014)[6]	Semistructured, open-ended interviews with veterans-consumers who participated in either peer facilitated groups (PFG) or clinician-facilitated groups (CFG) as part of a randomized trial.	13 PFG members and 11 CFG members with at least one psychiatric diagnosis.	Peers drew on their life experiences with mental illness to give perspective on participants' experiences, while clinicians drew on professional expertise that was lacking in patients.

health risks; however, there is little empirical evidence to support this.

Almost all people experience negative life events from time to time. In most cases, this causes no serious mental health problems. This means that although negative life events can be regarded as a risk factor, they should never be used as evidence of a mental disorder. Merely having experienced a negative life event should never be a reason to restrict a pilot from flying privileges. Suicidal thoughts and/or behavior as a reaction to negative life events are most likely the result of impaired coping mechanisms due to personality traits or an underlying mental disorder. Our study indicates that it is important that peers and medical examiners pay attention to the way pilots deal with more serious negative life events. The best way to do so is by showing genuine interest in the personal and professional life of the pilot without being intrusive. Only if a pilot him- or herself, or if peer supporters or aeromedical examiners find that there are serious coping difficulties, or fear that a mental disorder may be present should a pilot be referred for specialist mental examination. In case of coping difficulties, peer support may be helpful as well. In the United States and Australia, several peer support programs already exist.[53] Furthermore, in Europe, the 'European Pilot Peer Support Initiative' was set up to establish peer support programs in all European States; however, no follow-up data of this initiative are yet available.[27] Minor mental health complaints can be dealt with adequately by peer supporters and, in most cases, involvement of mental health professionals will not be necessary.

The recently established European Pilot Peer Support Initiative aims at collaboration between peer supporters and medical and mental health professionals. There are, in our opinion, many reasons why peer supporters and mental health professionals should collaborate. Preferably, treatment is provided by mental health professionals with some interest and knowledge of the aviation industry, and collaborating with peer support groups may be a good learning opportunity for them. Peer supporters need to be aware of the treatment options that are available. More importantly, they need to have confidence in professional mental healthcare, otherwise they cannot credibly encourage troubled colleagues to seek professional help. Pilots may also visit mental health professionals without contacting peer supporters. Although a mental health professional is responsible for providing a risk assessment and for providing adequate treatment, he or she may refer this pilot to a peer support group for help at a more practical level at the same time. Of course, medical professionals will have (as long as there is no imminent danger to others) an obligation to keep information on patients confidential. Peer supporters may have, as long as there is no danger to others, an obligation to provide confidentiality as well. In our opinion, collaboration could best be achieved by regular meetings of peer support groups (that may be union or airline based) and mental health professionals with some interest in the aviation industry. Airline management should facilitate this.

Just culture principles have been widely accepted in the aviation industry and applying just culture principles to mental health problems can be helpful in reducing the stigma of mental disorders. In our view, just culture means that a pilot should not be 'punished' by job or income loss because he or she was open and honest to peers or aeromedical examiners about life events or mental complaints. In case of minor mental health problems that pose no safety risk, the pilot should, where possible, continue flying while being closely monitored by a mental health professional who is in contact with the peer support system and, if necessary, with the airline and aviation authorities. In the more serious cases, a pilot may need to be grounded until the disorder has been treated to full remission. If it is necessary to restrict the flying privileges of a pilot temporarily or for a longer time in addition to treatment, psychosocial support should be provided and the pilot should be covered against income loss and against career impediments.

However, this comes with difficulties, as in most countries pilots risk losing their income if they are unable to fly due to mental health problems. This is especially the case for some low-cost carriers, which are often not unionized and often employ pilots without a regular employment contract.[40] Ideally, airlines should provide adequate insurance for disability as a part of collective labor agreements.

This study has several important limitations. First, all evidence discussed is retrospective, which induces the risk of recall bias. Also, retrospective studies have the disadvantage that they cannot establish causal relationships. Of course, aircraft incidents and accidents and suicidality can only be studied in a retrospective manner. We chose not to study the effects of alcohol and drug use, as its risks have already been well established and studying this again was beyond the scope of this article. However, it should be emphasized that addressing alcohol and drug use during any medical evaluation is highly important.[16,20,43] Acute psychotic symptoms caused one lethal accident and three incidents. We did not study this further as acute psychotic symptoms are extremely rare and almost impossible to predict. We also think that medical examiners and peers will recognize its cardinal symptom of impaired reality testing and will understand its danger.[50]

When studying airline pilot mental health scientifically, it is essential to pay attention to the incidents and accidents that have actually happened. Often only reports from popular media could be used as sometimes no official reports could be retrieved, or did not provide all relevant information. Popular media tend to be less reliable compared to official investigation reports, which poses an important limitation. We still decided to use this information, as pilot mental health problems and pilot suicide are highly stigmatized. Mental health problems can be an extremely delicate matter and may, therefore, not be incorporated into official reports, leading to underreporting of incidents and accidents.

Another limitation are the relative low numbers this study is based on. Although we tried to study professional groups comparable to airline pilots, differences between the various professional groups do exist. While they are not classified in the ISCO system, studies on military populations were included as they have to undergo, like pilots, a selection prior to obtaining their

job. Also, the articles on military populations were, on average, of high quality. Some studies, such as Tyssen et al., performed many statistical tests, which induces the risk of multiple testing and thereby of finding false-positive results. Also, most studies had only limited statistical significance, resulting in large confidence intervals. Finally, we included studies on both suicidal thoughts, attempts, and completed suicide. However, only a minority of the patients suffering from suicidal thoughts perform a suicide attempt, and only a minority of these attempts end in a completed suicide. Nevertheless, in our opinion all forms of suicidal ideation and behavior of pilots are a potential risk for aviation safety, and were therefore studied. For daily clinical practice, it is important that all suffering from serious suicidal thoughts and all contemplating suicide are restricted from flying privileges. Many people think about suicide from time to time without having any intention to commit suicide. Sometimes people discuss these feelings frankly and openly in a well-established and longstanding patient-physician or patient-therapist relationship. These individuals should not be restricted from flying as long as no serious mental disorder is present and they have healthy coping mechanisms. As we studied various types of evidence and the articles we discussed were highly varied regarding study populations, study sizes, and methodology, we used a narrative design for this study and did not attempt to combine the data into a meta-analysis. In our opinion, this is the best way to present the data in a structured and reliable way. Of course, direct observational studies to mental health risks in pilots are practically and ethically impossible. We think that it is highly important to obtain more insight into mental health problems in the airline pilot population. Most importantly, airline pilots' perceptions toward mental health care, mental health risks, peer support, and just culture based interventions for mental health problems should be studied. In our opinion, this can be done by establishing focus groups representing the airline pilot population. To this end, collaboration with pilots' unions could be useful. Studying the legal and practical challenges of applying just culture principles to mental health risks is also important.

In conclusion, our main finding is that when screening pilots for mental health risks, it seems to be important to pay attention to recent negative life events. This study is one of the first to provide a scientific basis for mitigating mental health risks. Since it is not based on clinical studies in airline pilots, we cannot prove causal relationships. This study, therefore, should not yet be used for regulatory purposes. Peer support programs and just culture principles seem to be useful, but more evidence for this should be established. Studying pilot mental health is challenging but highly important, and we hope that this article will lead to more research.

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