A survey of health effects in aircrew exposed to airborne contaminants

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Pilots and flight attendants are concerned about the perceived failure of the aviation industry and its regulators to address the problem of cabin air contamination and the health effects among aircrew following exposure to these contaminants. The aim of this paper was to survey a self-selected group of affected commercial aircrew (including 39 pilots) and document their symptoms and treatment. Various symptoms were reported by the aircrew, but neurological symptoms were present in nearly all cases. The symptoms affected the performance of the aircrew during flight, and there was a reluctance to report the fume events and symptoms. The problem of fume events represents a threat to the safety of those on board the aircraft and unacceptable health issues among aircrew. Although the problem is continuing to occur, it is not being systematically addressed.

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KEYWORDS

- AVIATION INDUSTRY
- COMMERCIAL AIRLINES
- AIRBORNE CONTAMINANTS
- HEALTH SYMPTOMS
- AIRCREWS

Introduction

Commercial pilots and flight attendants have been reporting health problems related to cabin air contamination for a number of years.[1,2] In 2000, the Australian Senate Inquiry concluded that engine oil vapours/fumes enter the aircraft through the airconditioning system and cause acute and long-term adverse health effects and disabling symptoms.[3] Pilots and flight attendants are concerned over the perceived failure by the airline industry and governments to address this problem.[4,5]

Particular concern is being felt by United Kingdom pilots.[6] This led the British Airline Pilots Association and the Association of Flight Attendants, in conjunction with the School of Safety Science of the University of New South Wales, to conduct an exploratory survey to document symptoms and treatment among aircrew who had been exposed to contaminated cabin air. The aim was to determine the extent and nature of the problem.

Method

The survey design was simple and included a self-selected group of affected aircrew. Pilots' and flight attendants' unions in the UK, Australia and the United States contacted their members to see whether they would submit a description of their symptoms and treatment in relation to contaminated cabin air. Data collection was not structured and respondents were self-selected. The data were analysed descriptively in terms of occupation, country of employment, aircraft type, dates of fume incidents, timing of the onset of symptoms during the flight, types of symptoms, duration of symptoms, work capacity and disability, diagnosis, treatment, and the health effects on other crew and passengers. Descriptive statements made by the respondents and reported comments from their doctors were examined. A descriptive analysis was undertaken.

Results

Respondent details

A total of 60 affected aircrew responded, including 39 pilots and 19 flight attendants. Two crew members did not specify their occupation. Of the respondents, 51% worked in the UK, 37% in Australia, 10% in the US and 2% in Egypt.

Aircraft type

The BAe 146 aircraft was overwhelmingly the most frequently involved in exposure events, but a number of other aircraft were reported (see Figure 1).

Exposure events

The reported exposure events began in 1986 and peaked in the late 1990s (see Figure 2) — although they continued up to the time of the study (February 2005).

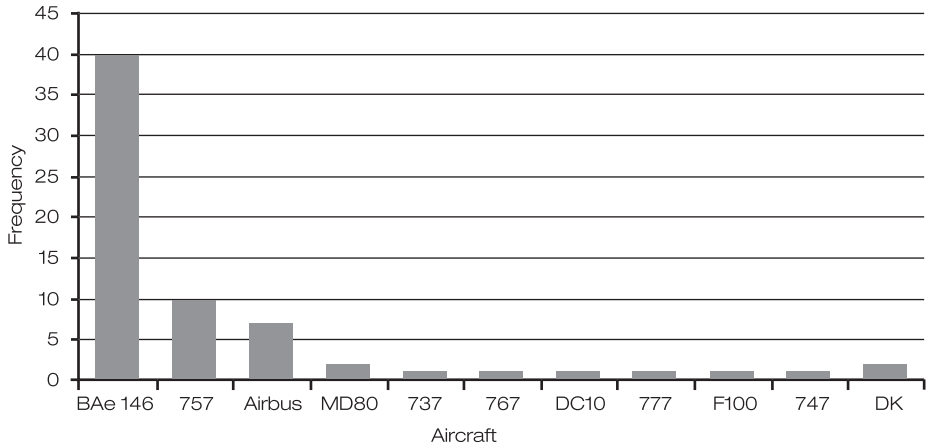
Exposure events were mostly experienced prior to take off and during ascent. Fewer events occurred while the aircraft were cruising or descending. Of the respondents, 40% experienced six or more exposure events (see Figure 3) and approximately half were aware of at least one other crew member being affected concurrently. Sixteen in the sample also reported passengers being affected.

Symptoms: range, onset, diagnosis and treatment

The symptoms experienced by the respondents were diverse and affected a wide range of body systems. Neurological symptoms (including impaired concentration, difficulty thinking, dizziness, making errors, and altered depth perception) were the most common, along with headache, fatigue and mucous membrane irritation. A number of respondents reported gastrointestinal, respiratory, skin and musculoskeletal symptoms (see Figure 4).

The onset of symptoms was sudden in 50% of cases, but approximately one-third did not comment on the time of onset. For more than half of the respondents, symptoms became chronic and persisted for months or years.

FIGURE 1
Aircraft type



The diagnoses reported were diverse. The most common were multiple chemical sensitivity, chronic fatigue syndrome, sinusitis, toxic encephalopathy, depression, reactive airways disease, and toxic exposure.

With regard to initial treatment, a number reported the use of oxygen in flight. Subsequent medical treatment did not follow a pattern, with the exception of the treatment of upper respiratory symptoms which were often diagnosed as sinusitis (and in four cases, treated surgically). Crew frequently commented that they felt that the severity of their illness was underestimated and the symptoms undertreated.

Work capacity was affected and 35% of crew reported that they were chronically unfit to fly. The following quotations are examples of the comments from crew and doctors. There were a number of descriptions of the exposure events and conditions inside the aircraft, ranging from the smell of "rotten socks" to comments such as:

> "There was grey-black smoke in the cabin and, from row three, the last three or four rows of passengers were not visible. I alerted the Purser who alerted the Captain and we actually thought there was a fire in the rear toilet."

A number of crew reported:

> "Extreme light-headedness."
>
> "No ability to focus or concentrate."
>
> "Feeling drunk as a skunk."
>
> "Having trouble judging distance to touch down."
>
> "I obviously did not have the presence of mind to consider handing over control to the First Officer."
>
> "I felt ill often but dismissed it, most of the time."

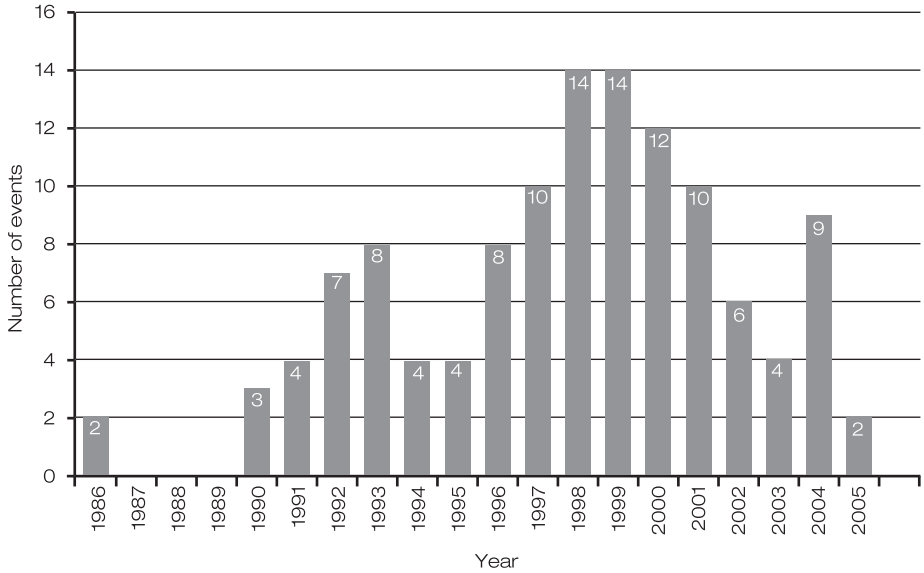
The crews' concern is reflected in statements such as:

> "I was worried that either one or both pilots one day would end up incapacitated in this particular aircraft [BAe 146]."
>
> "Toxic exposures are not only a health hazard but are a very real threat to the safety of flight and to the flying public."

Pilots commented on their reluctance to report exposure events:

> "I did not want to be labelled as an alarmist."
>
> "Job security and promotion prospects are a major reason why pilots do not document contamination defects."
>
> "There is a culture in the airline in which you try to look to [the] profitability of the aircraft and, if you can get away with it, you are expected to

FIGURE 2
Exposure events by year



take the stiff-upper-lip approach and ignore any problems which you may want to be convinced are of nuisance value only and do not concern health and safety."

"There was a marked reluctance from other pilots to effectively report occurrences of fumes."

"I was severely victimised by management."

Doctors' comments ranged from admitting to being "completely baffled" to stating that "toxic effects are not occurring". One doctor commented that:

"Because there exists no documentation of exposure to specific air contaminants, and because the reported symptoms are non-specific (and could possibly be related to a number of different factors), a determination of exposures or the work-relatedness of symptoms experienced in the past is not possible."

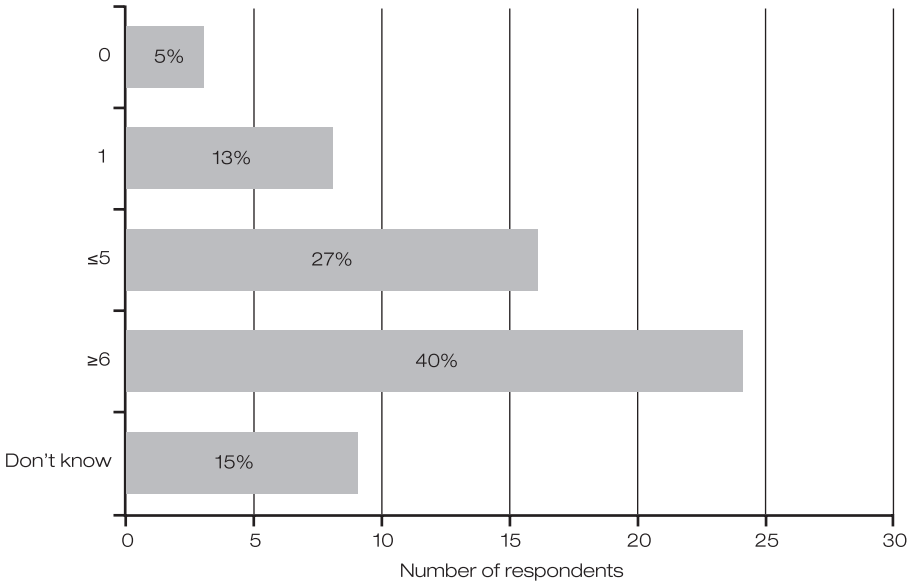
A more comprehensive perspective was expressed by another doctor:

"The phenomena of reactions to the BAe 146 cabin fumes cannot currently be fully explained, proved or disproved by the science of medicine, but that does not preclude the fact that those individuals that claim to be suffering such effects would appear to have symptoms of extreme illness in some cases. Rather than being rubbished and labelled as shysters or of unsound mind, these individuals are in fact our own modern-day canaries. They are telling us that something is definitely wrong and we as a community should be listening to them very carefully to enable sober research of the issue."

Discussion

Despite the simplicity of the investigation undertaken in this study, the results are an important barometer. Exposure events continue to occur, thus affecting the ability of pilots to fly and incapacitating flight attendants. There is an apparent wide variation in response to exposure events — presumably due to variations in individual susceptibility. For some crew, the health effects are moderately severe and sufficient to jeopardise aircraft safety; for others, the symptoms are chronic. Crew members have predominantly experienced the health effects in one type of aircraft but they have occurred in other aircraft designs. The health effects are not limited to crew — they also affect passengers. The pattern of

FIGURE 3
Number of exposure events by respondent



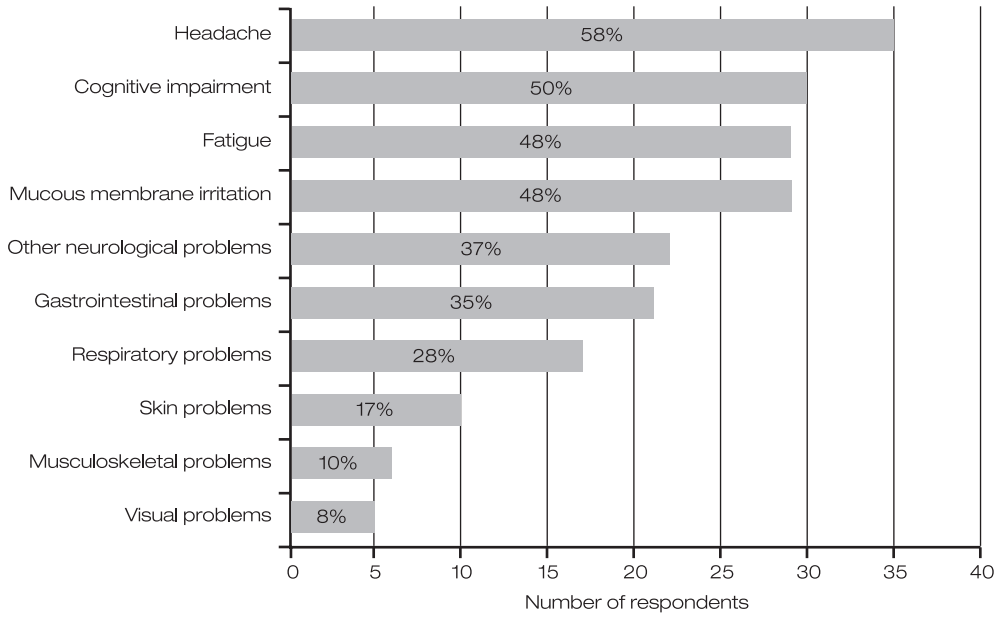
exposure events appears to be related to particular stages of the flight. Generally, the onset of symptoms coincides with an odour or fume event.

The reluctance of crew members to report the incidents is of great concern. Pilot behaviour in this regard appears to be variable; their reluctance to report and document incidents appears to relate to perceived management expectations and the fact that pilots do not want to be accused of overreacting. Consequently, they are reluctant to acknowledge that there is a problem or to use oxygen (as this needs to be documented). Fundamentally, they are not willing to jeopardise their careers.

The response of the medical profession is highly variable. At one end of the spectrum, there is rejection of the existence of a toxic cause, including a tendency to minimise the severity of symptoms and a tendency towards inaction on the grounds of insufficient evidence. In the middle of the spectrum, there is an admission of ignorance (however, in a number of cases, treatment has gone as far as surgical intervention). Towards the other end of the spectrum, there is acknowledgment of the presence of disabling symptoms and illnesses but this remains couched in the realisation that further enquiry and research are needed.

The question of whether the symptoms in aircrew are work-related is also of major concern. *Hill's Criteria of Causation* (described by Hill as "the application of commonsense") provide a framework which may help to answer this question.[7] With regard to consistency, there is a repetition of circumstances, observations and experiences among crews in different aircraft, in different places and at different times. There is specificity in the observations in that the onset of symptoms among pilots and flight attendants is specific to those who are flying and is not reported among ground staff. There is a close relationship between the time of exposure to fumes or smells in the aircraft and the time of onset of the symptoms. There is minimal lag time and the initial onset of symptoms is not being reported at other times. The occurrence of symptoms is plausible — both biologically and in terms of engineering. Organophosphate additives to engine oil are known to be neurotoxic and the use

FIGURE 4
Number of symptoms reported



of bleed air to supply the airconditioning system in the cabin explains how cabin air is contaminated. A cause and effect interpretation of the association between illness and flying has coherence with the biology and natural history of a neurotoxic disorder. Each crew member — when describing symptom onset following exposure, with subsequent recovery and then recurrence — provides his/her own experimental evidence as in an experiment with an "n of 1". This is a valid form of trial in which one individual repeatedly serves as both study subject and their own control. With regard to the development of a non-specific illness following exposure to synthetic chemicals at work, the cabin air experience of aircrew is analogous to a number of other occupational groups (notably, Australian F-111 maintenance workers, Vietnam veterans and agricultural workers). This reasoning suggests a causative relationship.

The alternative question is whether or not there is any explanation for this problem which is not work-related and does not arise from a chemical toxin in the cabin air. Possible alternative explanations are the occurrence of a psychological disorder, an infection, malingering, an artefact in the observations, a non-work-related chemical toxin, or some alterative medical diagnosis. Having considered all of these alternatives, each one appears improbable. Despite this view, there is strong opposition to accepting the fact that contaminated cabin air is a significant problem due to the health effects that it causes. Hill has sounded a warning regarding new health problems, saying that an observed association "may be new to science or medicine and must not therefore be too readily dismissed as implausible or even impossible".[8] As seen in the history of medicine, new illness precedes research, and scientific understanding of disease lags behind the occurrence. When faced with substantial differences between two groups, but with limited evidence, Hill has advised that the conclusion should be "not proven" rather than "no problem".[9]

The implication of the results in this study is that aircrew are continuing to experience a real problem — a problem which not only causes disabling and chronic health effects, it also presents significant problems with regard to air safety. Although the symptoms in aircrew are commonly undiagnosed,

the problem of contaminated cabin air is environmental and work-related and, when it occurs, it is nearly universally accompanied by cognitive and neurological symptoms.

Acknowledgment of the health effects associated with contaminated cabin air by employers and government is inadequate. Preventive measures are not in place and safety practices for exposure events are not standardised. Medical management is ill-defined, the treatment received by those affected is limited, and employers are failing to address the safety and health implications for both crew and passengers. The initiative to address the problem is coming from those who are affected (that is, pilots and crew), but the authorities seem to be reluctant to heed the warnings. Affected crew members are having to find ways to manage their symptoms relatively independently of the medical profession (a problem which commonly occurs with chemically related illnesses).

Conclusion

The health effects in aircrew who are exposed to contaminated cabin air need to be acknowledged. Primary prevention through the elimination of exposure is required and the safety procedures for exposure events must be upgraded. Prompt medical assessment for affected crew should be routine, as should comprehensive medical treatment. In addition, health surveillance of affected crew and an appropriate procedure for the workplace management of exposed and affected crew should be introduced. Appropriate health care should address the spectrum of symptoms experienced and occupational rehabilitation must be provided for those who are disabled.

The problem of cabin air contamination highlights the necessity to give priority to the health and safety of crew and passengers over business interests — which means reversing the current situation. The airlines and airline authorities need to acknowledge the problem and take precautionary measures rather than postponing action because of incomplete scientific understanding. The existence of a public health problem is undeniable. Doctors need to take a comprehensive occupational and medical history of affected crew in order to diagnose the problem and not rely on a physical examination and laboratory tests which, with this type of medical condition, fail to reveal the diagnosis. Solving this problem will depend on the collaboration, cooperation and coordination of all stakeholders but, unfortunately, the current divisions between employers and employees are holding back progress and perpetuating the problem.

A willingness by the medical profession to take public health action well in advance of full scientific understanding of the causative mechanisms of this problem is required — however onerous this may be. Our history of medicine is too easily forgotten: in 1854, John Snow cut short a cholera epidemic by the forthright, practical action of removing the handle from the Broad Street water pump.[10] This was 29 years before the discovery of the cholera bacterium. He used the available information to take responsible action. Let us follow his example.

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