

Causes and Diseases Leading to Early Permanent Medical Disqualification of Military Non-Pilot Flight Crews Based on Their Service Categories

H Shahali, A Amirabadi Farahani

Abstract

Background: Efficient workforce is the most important capital, and studies have shown a positive relationship between health and performance. Understanding the factors leading to disability has preventive importance.

Purpose: Determine the causes and diseases leading to early permanent medical disqualification of Iran air force non-pilot flight crews based on their service categories from 1986 to 2016.

Materials and methods: The study was designed as a descriptive, cross-sectional, retrospective investigation. The data were collected from Iran air force medical records and medical council files, sorted in a predesigned electronic sheet.

Results: Out of 228 cases of early medical discharges, 181 items were considered a medical disqualification, and the remaining 47 was for on service killed persons. The main causes were psychiatric, neurologic and otorhinolaryngeal, while common diseases include generalised anxiety disorder, occupational hearing loss and myocardial infarction. The lost service years were 2457 person-years, and the average was 13.57 person-years per individual.

Conclusion: Due to close similarities of pilots and non-pilot flight crews in the occupational environment, we expected that the results in pilots were referable to non-pilot flight crews but found they differed. The preparation of a flight crew requires many resources that are wasted with disability.

Keywords: Disabilities, disqualification, health, prevention, performance

Conflict of Interest: None

Introduction

Human resources are the most important capital of armed forces, and many studies have shown the strong links between personal health and organisational performance. To increase productivity, organisations have adopted numerous measures to evaluate preemployment health status and monitor staff health during their service life. Nonetheless, health risks remain the most important reducing factor of personal productivity. Disability is defined as the effect of a disorder on a person's physical, mental and social activity where

the work environment and the family status are also effective elements.¹⁻³ According to statistics, effective prevention of cardiovascular risk factors in the aviation population has a significant role in improving aviators' professional health index. The study of aviators' work environment and lifestyle, active intervention, regular periodic examinations and screening tests for early detection of diseases are among the basic measures.⁹

These days, the economic, mental and social problems caused by disability in armed forces are critical. Regardless of the huge cost to run and

maintain a powerful army, the supportive burden of victims can be devastating for any society.²⁰ In 1993, the United States (US) army paid 500 million dollars of compensation to newly recruited armed forces.^{6,7} A study conducted between 1980 and 1994 on the causes of disability in US air and sea forces showed how disability in armed forces led to a high cost (about 1.5 billion dollars) in compensation.¹ With an annual budget of more than \$200 billion in 2019, the US Department of Veterans Affairs (VA) is the largest single healthcare provider and administers an extensive disability compensation program. For Vietnam Veterans with VA service-connected disabilities, the total fiscal year 2013 expenditures for VA disability compensation and medical care exceeded \$22 billion: \$15.7 billion was spent on disability compensation payments and \$7.1 billion on medical care.¹⁷

The Federal Aviation Administration (FAA) conducted a large comprehensive study in 2014 on the causes of medical disqualification of pilots, listing 15 major causes, including angina pectoris, bipolar disorder, cardiac valve replacement, coronary artery diseases, diabetes mellitus, loss of consciousness with unknown reason, seizure, myocardial infarction, permanent pacemaker, disabling personal disorder, psychosis, drug abuse and dependency, and lack of neural control (in order of significance).¹⁵

The preparation of military non-pilot volunteers to enter professional training and the provision of optimal services in the form of well-trained non-pilot flight crews (NPFC) require a considerable amount of resources, both physical and intellectual.

The present study's ultimate goal was to determine the causes and diseases that led to early permanent medical disqualification (EPMD) of Iran Air Force (IRIAF) NPFC based on their service categories from 1986 to 2016. Other objectives include determining the exact number of NPFC killed in IRIAF, the lost service years (LSY) in IRIAF NPFC with EPMD (including four years of training and a total service duration of 30 years in IRIAF), the average LSY for IRIAF NPFC with EPMD and the provision of a scientific and practical solution to prevent the EPMD of IRIAF NPFC, based on their service categories.

Materials and methods

This study is descriptive, cross-sectional retrospective research. The target population was the IRIAF NPFC with EPMD from 1986 to 2016. NPFC in the IRIAF included service categories as flight engineer, navigator, crew chief, loadmaster, air traffic controller, mechanic, flight security, hostess, air operation,

boom operation and martial control. All IRIAF NPFC with medical disqualifications from 1986 to 2016 were selected, whose relevant official records had been documented during multiple medical sessions. However, NPFC with disqualification due to physical or mental illness and death in non-occupational accidents, non-medical reasons, personal requests or disciplinary punishments were excluded from the study. This study's ethical approval was issued by the Ethics Committee of the Aerospace and Sub-aquatic Medical Faculty, Aja University of Medical Sciences, with registration No: 10167105. The study was financed personally by the corresponding author, and no governmental or military funding was provided.

After intense coordination with relevant authorities in IRIAF's Department of Health, Medical Education and Services to obtain necessary permissions of unlimited access to designated medical records, focusing on the data's confidentiality aspects, the archivist assigned a non-disclosed random ID code to each record. Leading causes and diseases leading to EPMD, based on the 10th version of the International Classification of Diseases (ICD-10), were then read out of paper documents and entered into a Microsoft excel-based predesigned electronic data form along with other demographic information, including dates of entry into and departure from the service, and service categories. In a few cases, where more than one reason for EPMD, only the leading cause was considered. The tabulated information was sorted and summarised based on each service category with total LSY, and average LSY. The data were displayed in graph and figure format. Like other up-to-date military articles, we are reluctant to disclose a number of confidential military information (i.e. total number of cases).

Results

From 1986 to 2016, 228 cases of early permanent discharges were registered, including 47 (20.6%) killed or missed in action and 181 (79.4%) EPMD. The data are given in Table 1.

Among 16 total causes of EPMD in IRIAF NPFC, the most common causes included psychiatric, neurologic, otorhinolaryngeal, cardiac, neurosurgery and other causes in order of importance. The prevalence of the leading causes is depicted in Table 2. Of 74 EPMD diseases in IRIAF NPFC, the most prevalent diseases included generalised anxiety disorder, occupational hearing loss, myocardial infarction, lumbar discopathy, renal colic with multiple stones, and other diseases, shown in Table 3 (based on their service categories).

Total LSY in IRIAF NPFC was 2457person-years, where the most common causes were psychiatric, neurologic and neurosurgery, in origin, more details of which are displayed in Table 4. The top three diseases incurring greater LSY on IRIAF were generalised anxiety disorder, occupational hearing

loss and migraine. The number of total LSYbased on each specified disease's service categories is shown in Table 5. The average LSY in IRIAF NPFC with EPMD was 13.57person-years per individual, and the statistics were illustrated numerically in Tables 6.a and 6.b.

Tables:

Table 1: Demographic study data

	Flight engineer	Navigator	Crew chief	Load master	Air traffic controller	Mechanic	Flight security	Hostess	Air operation	Boom operation	Martial control	Sum
EPMD ¹	35	32	27	26	22	10	9	6	5	3	6	181
killed	3	12	4	5	4	3	5	2	4	3	2	47
Sum	38	44	31	31	26	13	14	8	9	6	8	228

1- EPMD: Early and Permanent Medical Disqualification

Table 2: Common causes of EPMD¹ of IRIAF² NPFC³

Occupation Cause	Flight engineer	Navigator	Crew chief	Load master	Air traffic controller	Mechanic	Flight security	Hostess	Air operation	Boom operation	Martial control	Sum
Psychiatric	8	7	5	4	2	2	2	0	0	0	1	31
Neurologic	8	4	2	2	1	0	2	2	1	0	0	22
ENT ⁴	2	3	3	3	5	2	2	0	0	0	0	20
Caradic	4	6	1	1	2	1	0	1	1	1	0	18
Neurosurgery	4	1	6	3	0	1	2	0	1	0	0	18
Other causes	17	13	10	12	7	3	2	1	1	2	4	72
												181

1- EPMD: Early and Permanent Medical Disqualification

2- IRIAF: IRAN Air Force

3- NPFC: Non-Pilot Flight Crews

4- ENT: Ear, Nose and Throat

Table 3: Common diseases leading to the EPMD¹ of IRIAF² NPFC³

Occupation Cause	Flight engineer	Navigator	Crew chief	Load master	Air traffic controller	Mechanic	Flight security	Hostess	Air operation	Boom operation	Martial control	Sum
Generalised anxiety disorder	3	2	0	1	1	2	0	0	0	2	1	12
Occupational hearing loss	1	1	0	3	3	1	2	0	0	0	0	11
Myocardial infarction	1	2	3	1	0	0	0	1	1	0	0	9
Lumbar discopathy	2	0	3	1	0	0	1	0	1	0	0	8
Renal colic with multiple stones	0	3	1	0	2	1	0	0	0	0	0	7
Other diseases	28	24	20	20	16	6	6	5	3	1	5	134
												181

1- EPMD: Early and Permanent Medical Disqualification

2- IRIAF: IRAN Air Force

3- NPFC: Non-Pilot Flight Crews

Table 4: Causes of LSY¹ of IRIAF² NPFC³ with EPMD⁴

Occupation Cause	Flight engineer	Navigator	Crew chief	Load master	Air traffic controller	Mechanic	Flight security	Hostess	Air operation	Boom operation	Martial control	Sum
Psychiatric	104	73	43	90	27	47	0	0	0	15	12	411
Neurologic	157	53	0	24	5	0	40	16	5	0	0	300
Neurosurgery	34	4	71	43	8	47	24	0	13	0	0	244
Other causes	155	244	191	252	237	90	119	104	41	22	47	1502
												2457

1-LSY: Lost Service Years

2-IRIAF: IRAN Air Force

3-NPFC: Non-Pilot Flight Crews

4-EPMD: Early and Permanent Medical Disqualification

Table 5: Diseases of LSY¹ of IRIAF² NPFC³ with EPMD⁴

Occupation Cause	Flight engineer	Navigator	Crew chief	Load master	Air traffic controller	Mechanic	Flight security	Hostess	Air operation	Boom operation	Martial control	Sum
Generalise anxiety disorder	49	30	0	27	8	47	0	0	0	15	12	188
Occupational hearing loss	1	17	0	42	35	17	40	0	0	0	0	152
Migraine	97	15	0	0	0	0	0	0	0	0	0	112
Renal colic with multiple stones	0	39	21	0	21	19	0	0	0	0	0	100
Diabetic miletus	3	10	28	32	10	14	0	0	0	0	0	97
Others diseases	300	263	256	308	203	87	143	120	59	22	47	1808
												2457

1-LSY: Lost Service Years

2-IRIAF: IRAN Air Force

3-NPFC: Non-Pilot Flight Crews

4-EPMD: Early and Permanent Medical Disqualification

Table 6.a: Average of LSY¹ of IRIAF² NPFC³ with EPMD⁴ according to causes

Occupation Cause	Flight engineer	Navigator	Crew chief	Load master	Air traffic controller	Mechanic	Flight security	Hostess	Air operation	Boom operation	Martial control
Psychiatric	17.21	11	14.34	22.5	13.5	23.5	0	0	0	7.5	12
Orthopedic	9.75	0	13.25	13.75	13	10	0	22.5	14	0	19
Oncologic	0	9	11.5	5	19	0	22	19	0	0	0
Other causes	9	10.52	12.45	11.3	10.26	9	14.2	17.75	11.25	7	0

1-LSY: Lost Service Years

2-IRIAF: IRAN Air Force

3-NPFC: Non-Pilot Flight Crews

4-EPMD: Early and Permanent Medical Disqualification

Table 6.b: Average LSY¹ of IRIAF² NPFC³ with EPMD⁴ according to diseases

Occupation Cause	Flight engineer	Navigator	Crew chief	Load master	Air traffic controller	Mechanic	Flight security	Hostess	Air operation	Boom operation	Martial control
Specific flight phobia	26.02	0	0	0	0	0	0	0	0	0	0
Migraine	24.25	15	0	0	0	0	0	0	0	0	0
Psychosis	5	15	28	19	0	0	0	0	0	0	0
Renal colic with multiple stones	0	13	21	0	10.5	19	0	0	0	0	0
Generalised anxiety disorder	16.34	15	0	27	8	23.5	0	0	0	7.5	12
Other diseases	8.6	9.38	9.89	10.4	10.84	15.5	17.5	18	10.5	0	0

1-LSY: Lost Service Years

2-IRIAF: IRAN Air Force

3-NPFC: Non-Pilot Flight Crews

4-EPMD: Early and Permanent Medical Disqualification

Discussion

Civil and military NPFC play a significant role in the aeronautics industry of Iran and the world. Together with their pilot colleagues, they guarantee the safety, health and comfort of the community. Preparing flight crew to enter professional training courses and delivering desirable services in the form of expert military aviators demands extreme capital and personal costs. Accordingly, any disqualification will be a major loss of funding and human capital for armed forces. Thus, control of this needs effective prevention.¹⁻⁵

The timely cognition and precise determination of the prevalence and causes of diseases leading to their EPMD may lead to the design and development of effective methods for diagnosis, prevention, treatment and rehabilitation. Unfortunately, studies reporting civil or military NPFC throughout the world are scarce, and the present investigation is an exclusive study to encourage researchers to do similar studies in the field.

The main reasons for EPMD of IRIAF NPFC during the study included psychiatric, neurologic, otorhinolaryngeal, cardiac and orthopaedic disorders. In any armed forces, while in drills or real battle, casualties are inevitable and killed NPFC are not considered to be among the lost years of service and are assumed as missed data.

Since similar studies in Iran and the world have not been designed with the same duration and target population, findings of this study can be compared with the results of studies performed in similar populations in other countries due to the dissimilarities of the work environment (i.e. the cabin condition) of the pilot and non-pilot flight personnel. Indeed, as the differences in flying devices and working conditions of flight personnel in different countries, it seems reasonable to simultaneously express the findings of studies in Iran and other countries.

In a study by Montazeri(2005), the most common causes for EPMD of IRIAF pilots were cardiovascular and neuro-skeletal irregularities.¹⁹ In Ghazizade's (2010) study, cardiovascular, neuroskeletal and digestive causes were more common in the same population, but involved different samples between 1992 and 2003.¹⁸ The diseases that led to the pilots' medical disqualification were not assessed. However,

both studies were conducted on pilots only and the duration of studies was less than a decade in both cases.

In a study on US Air Force pilots and navigators (USAF) by Whitton(1984), common causes were cardiovascular and neurological,¹⁶ while in a survey by McCrayry(2002) on a similar population between 1995 and 1999, the most common causes were cardiovascular, musculoskeletal, neurologic and endocrine disorders.¹¹ In Dark's study (1986), with the help of the FAA to disqualify American airline pilots between 1983 and 1984, the most common causes were cardiovascular and neuropsychiatric events.¹⁸ In the study by Nakanishi (2003), 260 Japanese crew members with a permanent disability, the most important causes included malignancies, neuropsychiatric disorders, cardiovascular, gastrointestinal and musculoskeletal disorders.⁸ In a study in Commonwealth countries on disqualified pilots between 1994 to 2004, cardiopulmonary disorders were the leading cause.¹⁸ In Arva's study (2004), Regarding the 257 Norwegian civilian pilots, the main causes include cardiovascular, neurological, musculoskeletal and psychiatric diseases.¹⁰ In both studies by Mitchell (2004) and Evan (2006), investigations on the sudden incapacitation of British Civilian Pilots from 36 incidents, half were caused by cardiac or cerebrovascular accidents, and mental disorders were one of the leading causes.^{12,13} In Nezami's research on 200 civilian pilots of Vnukovo airport (Moscow), cardiovascular, nervous and digestive causes were the leading causes of disqualification.⁹ In summary, cardiovascular, neurological and musculoskeletal causes are the most common causes of medical disqualification in these studies.

Common diseases leading to EPMD in IRIAF NPFC during the present 30-year study included generalised anxiety disorder, occupational hearing loss, myocardial infarction, lumbar discopathy and renal colic with multiple stones. However, in McChary's (2002) review of USAF pilots and navigators in 1995–1999, more common diseases were ischaemic heart disease, high blood pressure, back pain, intervertebral disc and migraine disorder.¹¹ In the 2011 study of Nezami, on 200 civilian pilots in Vnukovo airport, ischaemic heart disease, myocardial infarction, high blood pressure, atherosclerotic lesions of the cerebrovascular and peptic ulcers were most common.⁹ In our study, myocardial infarction was one of the most common diseases.

In February 2014, the FAA published a statement on its official website as 'FAA's 15 disqualifying aviation medical conditions for prospective pilots', five of the most common being angina pectoris, bipolar disease, cardiac valve replacement, coronary heart disease and diabetes mellitus.¹⁵ However, these are for pilots and may be expandable to NPFC.

The total LSY was 2457 person-years, the highest rates related to psychiatric, neurologic and neurosurgery causes. The diseases with the most LSY burden included generalised anxiety disorder, occupational hearing loss and migraine. The average LSY was 13.57 person-years per individual, and the highest were due to psychiatric, orthopaedic and oncologic causes, as well as flight phobia, migraine and psychosis. In Montazeri's (2005) study, the mean LSY in IRIAF's medical retired personnel with EPMD was 6.6 person-years.¹⁹ In the Ghazizade study conducted for disabled persons at the IRIAF hospital from 1992 to 2003, the average LSY were 6.14 person-years per individual. The highest figure was 10 person-years.¹⁸

The limitations of the present study include:

1. Missing details due to the lack of presence of a comprehensive electronic system for recording personal medical records
2. the possibility of oriented malingering in disorders where specific objective diagnostic methods are not available and were mostly diagnosed subjectively, such as motion sickness, migraine, irritable bowel syndrome etc.
3. flying device factors (ergonomics and exhaustion), operational and airbase factors (work and rest schedule), personal factors (lifestyle, physical and psychological capabilities, socioeconomic state, use of legal and illicit drugs and habits), medical factors (medical and psychological advices and hygiene education) which have effective influence on cadet health.

The present investigation has important advantages such as:

1. being the first reported study on EPMD of military NPFC
2. the longest cross-sectional period (35 years)—the closest was performed during a 10-year period¹⁸
3. express the statistics of IRIAF killed NPFC
4. records were sorted according to the service categories.

More studies should be conducted on military and civil NPFC in the future as we believe that lifestyle modifications, regular fitness training,

hygiene and health education, and medical and psychological counselling for preventing the EPMD in military NPFC are necessary preventive steps to take. The authors also recommend using up-to-date comprehensive electronic systems, upgrading on-the-job examinations, sufficient periodic in-service examinations in occupational health centres. Unfortunately, there has not been a similar military study published with worldwide data so far, making it necessary to accomplish this research more effectively and strategically.

Acknowledgements

This study was conducted by personal funds of the corresponding author and received no governmental or military financial support.

Ethical approval

This study's ethical approval was issued by the Ethics Committee of the Aerospace and Sub-aquatic Medical Faculty in Aja University of Medical Sciences, with registration No: 10167105.

Abbreviations

NPFC: non-pilot flight crews

EPMD: early permanent medical disqualification

IRIAF: Iran air force

LSY: lost service years

US: United States

USAF: United States Air Force

FAA: Federal Aviation Association

ICD-10: international classification of diseases

Contributorship:

Dr Azade Amirabadi Farahani, MD, was my main teammate and was involved in searching for similar studies, data collection and statistical analysis as an erudite researcher. I would like to introduce her as my co-author.

Corresponding Author: Hamze Shahali hamze.shahali@ajaums.ac.ir

Authors: H Shahali¹, A Amirabadi Farahani²

Author Affiliations:

1 Aja University of Medical Sciences, Aerospace & SubAquatic Medical Faculty

2 Tehran University of Medical Sciences, Anatomical and Surgical Pathology

References:

1. Jones BH, Perrotta DM, Canham-Chervak ML, Nee MA, Brundage JF. Injuries in the Military. *Am J Prev Med.* Apr 2000;18(3 Suppl):71-84.
2. Nagi SZ. *Disability and Rehabilitation.* Columbus: Ohio State University Press, 1969.
3. Wood PHN. Appreciating the Consequences of Disease: The International Classification of Impairments, Disabilities and Handicaps. *WHO Chronicle:* Oct 1980;34(10):376-80.
4. Harris L and Associates, Inc. *The ICD survey of disabled Americans.* International Center for the Disabled, New York. 1986.
5. Pope AM, Tarlov AR, eds. *Disability in America: Toward a National Agenda for Prevention.* Washington DC: National Academy Press. 1991.
6. McNeil JM. *Americans with disabilities:1991-92.* U.S. Bureau of the Census, Current Population Reports, Series P-70, Household Economic Studies. No.33. 1993.
7. Songer TJ, LaPorte R. Disabilities Due to Injury in the Military. *American Journal of Preventive Medicine:* Apr 2000;18(3, Supp 1):33-40.
8. Nakanishi K, Ohruji N, Nakata Y, Hanada R. Long-Term Disability Among Aviators in Japan Air Self Defence Force: Analysis of 260 Cases. *Aviat Space Environ Med.* 2003;74:966-9.
9. Nezami Asl A. *Main causes for disqualification of civilian pilots in Vnukovo airport [Dissertation].* [Moscow]: Sechinova University of Moscow. 2011:170.
10. Arva P, Wagstaff AS. Medical Disqualification of 275 of Norwegian Commercial Pilots: Changing Patterns Over 20 Years. *ASMA.* Sep 2004;75(9):791-794(4).
11. McCrary BF, Van Syoc DL. Permanent Flying Disqualifications of USAF Pilots and Navigators (95-99). *Aviat Space Environ Med.* Nov 2002;73(11):1117-21.
12. Evans S, Radcliffe SA. The Annual Incapacitation Rate of Commercial Pilots. *Aviat Space Environ Med.* Oct 2006;77(10):1077-9.
13. Mitchell SJ, Evans AD. Flight safety and Medical Incapacitation Risk of Airline Pilots. *Aviat Space Environ Med.* Mar 2004;75(3):260-8.
14. McCormick TJ, Lyons TJ. Medical Causes of In-Flight Incapacitation: USAF Experience 1978-1987. *Aviat Space Environ Med.* Sep 1991;62(9 Pt 1):884-7.
15. Federal Aviation Administration. *FAA's 15 Disqualifying Aviation Medical Conditions for Prospective Pilots*[Internet]. WashingtonDC: FAA. Feb 2014. Available from: <http://flightphysical.com/pilot-medical-certification/disqualifying-conditions>
16. Whitton RC. Medical Disqualification in USAF Pilots and Navigators. *Aviat Space Environ Med.* Apr 1984;55(4):332-6.
17. Helmer D, Tseng C, Rajan M, Fried D. Total and per-patient Fiscal Year 2013 VA disability compensation and medical care expenditures and utilization for Vietnam Era Veterans with service-connected disabilities. *JMVH.* 2021;29(1):15-26.
18. Dark SJ. *Medically Disqualified Airline Pilots.* FAA Civil Aeromedical Institute, Office of Aviation Medicine, Oklahoma City, USA. June 1986.
19. Ghazizade C. Aetiology Assessment of Early Disqualification and Retirement of IRIAF Pilots. *EBNESINA.* Mar 2010;12(1):11-5(5)[Persian]
20. Montazeri B, Mardani A, Shamshiri B, Panjeband M. Rate Assessment of Different Aetiology in About IRIAF Personnel Disqualification and Lost Working Years between 1992 to 2003. 2th Global Seminar of Occupational Medicine. Aja University of Medical Sciences, Tehran. Feb 2003 [Persian]
21. *Final Reports of the Secretary Defence. Military Health System Review*[Internet]. WashingtonDC, U.S. Department of Defence. Aug 2014. Available from: https://archive.defense.gov/pubs/140930_MHS_Review_Final_Report_Main_Body.pdf