Retrospective Analysis of Medical Attrition for Pilot Applicants to the British Army Air Corps

Mark S. Adams; Claire E. Goldie; Steven J. Gaydos

INTRODUCTION: Management of aeromedical risk is essential for flight safety. Given the many operator stressors for pilots, militaries maintain a vested interest in selecting aircrew applicants who meet rigorous initial medical standards. Very little published literature exists regarding the extent of medical disqualifications or precluding conditions for initial candidates.

METHODS: For the British Army, pilot selection is a phased, multistep process that includes Phase I medical screening followed by a comprehensive Phase II medical exam. De-identified summary data were retrospectively reviewed for medical fitness and disqualifying categories for the 5-yr period of 2018–2022, inclusive. For those ultimately deemed unfit for aviation service, etiology was grouped into general categories.

RESULTS: Approximately one-third (30.2%) of candidates were disqualified at Phase I initial medical screening with leading categories of attrition due to respiratory etiology, especially a history of asthma or reactive airway disease, followed by ophthalmology. For the Phase II medical exam cohort, 21.0% were medically disqualified with most attrition from anthropometry and ophthalmology. There were no statistical differences in disqualifications for gender or pathway of entry (civilian vs. serving personnel).

DISCUSSION: Major categories of medical attrition were similar to that of other nations, yet the published literature in this area is surprisingly tenuous. Given the desire for evidence-based medical selection standards, it is important for regular review of processes and standards such that the risks of known physiological challenges are judiciously weighed with the benefits of a large, diverse pool of selection as well as force structure and recruitment demand.

KEYWORDS: medical selection, medical disqualification, rotary-wing, military pilots.

Adams MS, Goldie CE, Gaydos SJ. *Retrospective analysis of medical attrition for pilot applicants to the British Army Air Corps*. Aerosp Med Hum Perform. 2023; 94(12):939–943.

The requirement for special medical screening and fitness exams for certain high-risk or safety-critical occupations has existed in various forms for well over a century. Most modern advances in assessing worker fitness for special occupations came with the Industrial Revolution, but evidence exists much further back in the history of occupational medicine.[3] For the aviation community writ large, interest in medical standards and fitness for duty emerged from the very beginning of powered flight, especially for the military.

Pre-World War I, it was the Italians who were first in establishing a pilot selection research program (including physicians, psychologists, and physiologists), but Germany was the first to develop and publish special aeromedical standards for pilots in 1910.[2] Other nations quickly followed suit, including the United States (1912), Germany (revised, 1915), United Kingdom (1916), and France (1917).[2] With aviation medicine in its infancy, testing and standards were relatively arbitrary and of questionable validity in many instances, but medical screening, standards, and selection matured in parallel with scientific advances in both aviation and medicine.[4]

Management of aeromedical risk is essential within all aviation operations. Given the many operator stressors for

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This manuscript was received for review in July 2023. It was accepted for publication in September 2023.

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DOI: https://doi.org/10.3357/AMHP.6342.2023

military pilots—acceleration, hypobaria, hypoxia, thermal extremes, noise, vibration, fatigue, disorientation, and others—all militaries maintain a vested interest in selecting and training those aircrew applicants who meet rigorous initial medical standards. Fundamentally, this is no different than the commercial and civil aviation communities, though they are less concerned with related risks of world-wide deployability, austere operating environments, high-performance flight envelopes, officer career longevity, and other military-specific hazards. While it is assumed that most military services maintain internal audits, very little published literature exists regarding the extent of medical disqualifications or precluding conditions for aircrew candidates. This is especially true for army forces or rotary-wing (RW) specific formations (we found only one such study). The overwhelming majority of literature focuses on disqualifications or suspensions of extant trained or rated aircrew (aeromedical risk is often managed differently for this cohort) or concentrates on specific diseases or pathological conditions.

Groner et al. recently published a review of the Israeli Air Force Flight Academy in which 15.8% of candidates were disqualified from aviation service with ophthalmology, asthma, allergic rhinitis, renal/urinary, and otolaryngological conditions as the most prominent medical categories.[5] The Indian Air Force also analyzed its pattern of initial medical disqualifications (36.2%) with ophthalmology as the main category followed by radiological/spinal abnormalities and anthropometric incompatibility.[8] These findings were then compared with data from the U.S. Air Force Aeromedical Consultation Service, with 44.5% of candidates disqualified with ophthalmological and systemic medical conditions most prevalent.[11] The Singapore Air Force reported the highest proportion of disqualifications, with only 58.7% of initial applicants meeting standards for their selection examination.[7] Precluding categories in this study were similar to others with ophthalmology, anthropometry, and otolaryngology as the three leading etiologies. Interestingly, noting differences in the recruiting pool for Army pilots specifically (often a larger cohort of in-service, older candidates), Sahu and Sasirajan compared differences in initial medical examination qualifications among Army vs. Air Force and Navy applicants, noting a higher percentage of disqualified applicants. They cited slightly different primary disqualifying categories of orthopedic abnormalities and otolaryngological conditions.[10] Despite the paucity of literature, it remains important for services to analyze retrospective data regarding stringent medical accessions for aircrew training to ensure screening remains valid and effective. Sharing of such information serves to enhance the multinational aeromedical base of knowledge, scientific collaboration, and aviation safety.

METHODS

For the British Army, pilot selection is a phased, multistep process. Initially, all applicants must first be found fit for general military service (disqualifications in this case are beyond the scope of this manuscript). From that large cohort, medical histories of Army pilot candidates are initially reviewed during a Phase I preselection screening process. This review may take place as either a face-to-face (F2F) health records review with a medical officer for currently serving military, or via preselection questionnaire (with supporting health records as requested) for civilian applicants. Ostensibly, both parallel entry processes focus on and achieve the same result to flag common disqualifying conditions prior to investiture of further resources dedicated to applicant selection, both medical and nonmedical. Medically qualified applicants from this Phase I process proceed onward to a series of nonmedical test batteries, including leadership and flight aptitude. Passing candidates who qualify then receive a thorough aircrew medical exam during Phase II. These exams are conducted at a single, centralized location with standards of aviation fitness from a tri-Service Air Publication. This Phase II medical exam is also known as an "Aircrew Medical Board," and board results are valid for a 5-yr period. Those found to meet medical standards then proceed onward to a flying grading assessment and subsequent pilot selection board. The process is depicted in **Fig. 1**. At each phase of medical assessment, candidates are grouped into one of three categories: medically fit for aviation duty (FIT), temporarily unfit aircrew (TUA; typically missing supporting documentation or awaiting further testing/clarification), or permanently unfit aircrew (PUA) if medical standards are definitively not met. The relatively small number of TUA candidates may eventually become FIT provided full resolution of uncertainty or ambiguity. This is not universal, however, in which case they are then ultimately categorized as PUA.

This project was a retrospective, descriptive observational study without formal hypothesis testing. Applicant data and dispositions are maintained within a de-identified database as part of regular policy review. De-identified summary data were retrospectively reviewed for medical fitness and disqualifying categories for the previous 5-yr period of 2018–2022, inclusive. This interval was selected because the Aircrew Medical Board is valid for a 5-yr period, and gender classification was not

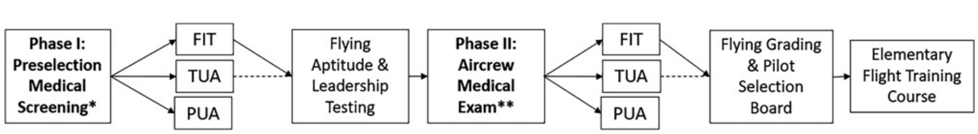

Fig. 1. Applicant aircrew medical certification process. *For applicants currently in service, this is conducted with a face-to-face heath records review with a medical officer. For civilian applicants, this is conducted via preselection questionnaire with supporting health records. **Standards for aviation medical fitness are tri-Service. Aircrew medical exams are conducted at a single centralized location.

complete for candidates prior to 2018. For those ultimately deemed PUA, etiology of medical disqualification was grouped into general categories. The service audit was determined exempt via Joint Service Publication regarding governance of research, and no personally identifiable data was retrieved or used for analysis. Data management and statistical analysis were completed with Microsoft Excel®, ver. 2018.

RESULTS

For the 5-yr period of investigation, a total of 573 individuals (16.8% women) underwent Phase I medical screening via the preselection questionnaire pathway, with 69.8% found FIT through this initial assessment. Of those determined to be PUA at this phase, the majority of attrition was due to respiratory etiology, especially a history of asthma or reactive airway disease, followed by ophthalmology. Other causes are outlined on the left of **Table I**.

For those currently serving military applicants who received the alternative F2F health records review with a medical officer, disqualification numbers and etiology for PUA candidates are not collected centrally and therefore unavailable for comparison. However, all qualified candidates from both processes proceed onward per Fig. 1. There remains significant nonmedical attrition prior to the Phase II Aircrew Medical Exam, with only about a third of the Phase I medically qualified applicants ultimately completing the comprehensive Phase II medical assessment. This may be due to substandard performance in flying aptitude, failure of leadership testing, loss of interest, diversion to other military specialty, or other reasons (etiology of nonmedical attrition is beyond the scope of this project). Of this Phase II cohort, 21.0% were determined to be PUA and subsequently medically disqualified. The majority of attrition was due to anthropometry followed by ophthalmology. Other causes are outlined on the right in Table I.

Table I. Attrition for Preselection Medical Screening (Phase I) and Aircrew Medical Exam (Phase II).

	PHASE I PRESELECTION MEDICAL SCREENING		PHASE II COMPREHENSIVE AIRCREW MEDICAL EXAM	
CATEGORY OF ATTRITION	MALE (%)	FEMALE (%)	MALE (%)	FEMALE (%)
Respiratory	35.7	1.9	10.5	–
Anthropometry	9.1	6.5	31.6	8.8
Ophthalmology	26.0	3.9	21.0	1.8
Otolaryngology	2.6	–	8.8	–
Mental/ Behavioral Health	0.7	1.9	5.3	–
Neurology	5.8	3.2	8.8	–
Orthopedic	1.3	–	–	–
Gastroenterology	1.3	–	–	–
Dermatology	0.7	0.7	–	–
Renal/Nephrology	–	–	1.8	–
Other/unclassified	–	–	1.8	–
Total	81.8	18.2	89.5	10.5

There was little difference in comparison of Phase II PUA disqualifications between the two initial Phase I cohorts with parallel screening processes of F2F health records review with a medical officer for currently serving military (21.7%) and that of preselection questionnaire (with supporting health records as requested) for civilian applicants (20.6%). However, there was a statistical difference for those dispositioned as TUA with due consideration to the differences in processes [$\chi^2(2270) = 6.56$, $P = 0.04$]. Of those receiving final aeromedical disposition, there was no statistical difference in gender among those candidates found to be FIT vs. PUA for either Phase I [$\chi^2(1544) = 0.69$, $P = 0.41$] or Phase II [$\chi^2(1163) = 0.42$, $P = 0.52$]. Specifically for female applicants, medical disqualification differed from male applicants with anthropometry as the leading category for both Phase I and II processes.

DISCUSSION

The present study provides interesting insights into initial disqualifying conditions for pilot applicants to the British Army Air Corps. As is the case with most nations, the selection process is under regular surveillance and evaluation in order to respond to evolving challenges and demands required of military aircrew. It is important not only to review these processes regularly, but also to share information within the wider aeromedical community. Review of screening and selection processes are also important to understand common areas of attrition, and to ensure standards match requirements. The leading two disqualification categories for preselection medical screening were respiratory and ophthalmology, and these results closely mirror those of the recent Israeli study, with ophthalmology and asthma as the most prominent medical categories.[5] Sahu and Sasirajan's analysis (the only study published specifically for Army applicants that the authors could locate in the literature) noted slight differences, with 33.9% of applicants declared permanently unfit with spinal abnormalities/orthopedic and otolaryngological as the majority of conditions.[10] However, these authors note that the mean age of applicants was older, owing to a larger applicant cohort coming into screening with existing military service. Unfortunately, in our review, the Phase I medical screening cohort does not reflect those candidates who enter screening through the existing service pathway (these PUA candidates are not maintained centrally and therefore unavailable for comparison). However, it is reassuring in our review that the percentages of ultimate disqualification determined during the Phase II Aircrew Medical Exam were not substantially different (20.6% vs. 21.7%) given the two parallel initial screening pathways. The statistical difference in those determined to be TUA at this Phase is secondary to the fact that more comprehensive medical history is afforded at the F2F screening for existing service personnel. One of the key aids to making an ultimate determination of fitness is timely access to comprehensive and accurate primary health care records from birth, especially when considering past history of disqualifying conditions such as childhood asthma. For these reasons, this program of dual parallel processes is currently under scrutiny with the Army's Consultant Adviser for Aviation Medicine secondary to this review. The Phase II Aircrew Medical Exam highlighted the leading etiologies of anthropometry and ophthalmology for attrition. This was again similar to the recent Groner et al. study, as well as that of the air forces of India (cf. ophthalmology, radiological/spinal abnormalities, and anthropometric incompatibility) and Singapore (cf. ophthalmology, anthropometry, and otolaryngology).[5,7,8]

Ophthalmological conditions accounted for substantial numbers of attrition for both Phases I and II, and this was also reflected within the limited extant literature on medical accessions. Specifically for the medical exam, it is often the first opportunity for a comprehensive ophthalmological exam complete with cycloplegic refraction, detailed color testing, slit lamp biomicroscope, retinal imaging, corneal topography, and other advanced diagnostic procedures. Within this category, the leading diagnoses were excessive refractive error, followed by color vision deficiencies, defective stereopsis, and excessive phorias. Regarding the large proportion of initial Phase I medical attrition due to respiratory etiology and asthma, Porter and colleagues assessed the impact of the prevalence of asthma on the available cohort of military service candidates within the United Kingdom in order to estimate the prevalence of those who could be expected to be found unfit for aviation service. The authors concluded that not only does asthma continue to constitute a significant issue for general public health, but "…will continue to complicate the recruitment, training, and retention of military personnel for the foreseeable future."[9] It is likely to remain a substantial cause of military aviation disqualification within the United Kingdom, particularly as policy has become more stringent within the last year (Army Consultant Adviser Aviation Medicine. Personal communication; June 2023), and remains a universal recruitment issue of varying degree for all military aviation formations.

Anthropometry accounted for the leading category of attrition for Phase II PUA disqualifications. This has been cited as a prominent etiology in other studies, as mentioned previously, and this is not surprising in our review given the scrutiny that this has received within the British Army Air Corps for the inclusive years of the analysis. The requirement for physical size, form, and functional capacity appropriate for various airframe cockpits is self-evident with respect to the traditional measurements of occupant sitting height, arm reach, buttock-knee length, etc. Although there were no significant differences found in overall disqualifications for gender, anthropometry was the leading disqualifying category in women for both Phase I and Phase II processes. Interestingly, failure to meet anthropometric standards was also the leading disqualification for a previous U.S. Army review of female applicants for flight training (followed by ophthalmology).[6]

However, regarding anthropometry, an equally important issue—and the principal reason for recent scrutiny—is that of weight, specifically all-up-mass (AUM). Helicopter crashworthiness is predicated upon life-saving energy absorption systems. Occupant stroking seats and restraint harnesses are designed to function and withstand decelerations for a specified range of occupant AUM in order to maintain peak G forces below injurious levels.[1] Furthermore, in addition to occupant mass, one must also account for uniform items, aircrew equipment assemblage, body armor, personal weapon/ammunition, protective survival equipment, and related accoutrements. In certain operational environments (e.g., active combat, overwater maritime, or overland artic cold weather), the additional aircrew-borne mass can be significant (exceeding 20 kg in some cases), thus driving the pilot nude bodyweight lower in order to keep the AUM within the engineered crashworthiness envelope. This has been followed closely by the Army Air Corps, as well as the complicating factor of longitudinal increases of body mass index for pilots over a service career. To inform future policy formulation related to body composition of aviation applicants, a recent retrospective analysis of longitudinal changes in body mass index for British Army Apache pilots demonstrated a mean increase of approximately 0.5 kg of weight per year (similar to the general population) (Army Consultant Adviser Aviation Medicine. Personal communication; June 2023).

It is important to comment on two major events within this study timeframe with potential for atypical annual recruiting cohorts for the Air Corps. The first is that of the novel coronavirus global pandemic, COVID-19 (previously known as severe acute respiratory syndrome coronavirus 2 or SARS-CoV-2). In a similar way, this likely affected recruitment and training for military flight applicants worldwide. The second, specific to the United Kingdom, was a large-scale change in the oversight, management, and delivery of military flying training within the Ministry of Defense known as the Military Flight Training System. Whereas RW flying training was historically a service specific delivery, this included commencement of an RW-only training pathway for helicopter pilots through a joint Defense Helicopter Flying School (including new training contracts and aircraft within this study period). Neither of these two events specifically impacted medical screening and selection standards or processes, but both likely resulted in some degree of anomalous applicant numbers as training throughput was significantly affected.

In summary, it is reassuring that we did not find substantial differences in major categories of applicant medical attrition from that of other nations' military air services, yet the published literature in this area is surprisingly sparse. Given a strong desire for evidence-based medical selection standards for aviation service, it is important for regular review of processes and standards such that the risks of known physiological challenges are judiciously weighed with the benefits of a large, diverse pool of selection, as well as force structure and recruitment demand. Furthermore, our aeromedical community must continue working toward open communication and collaboration within this import aeromedical base of knowledge, especially as military aviation partnerships increase within a milieu of multinational and allied operations.

ACKNOWLEDGMENTS

The authors wish to thank Anthony Waterman of the U.S. Army Aeromedical Research Laboratory Science Information Center for his technical assistance as a research librarian. The views, opinions, and/or findings contained herewith are those of the authors and should not be construed as an official UK Ministry of Defence or U.S. Department of Defense position, policy, or decision, unless so designated by other official documentation. This work is original, has not been published elsewhere, and is not currently under consideration by another journal.

Financial Disclosure Statement: The authors have no financial interests or other relationships that may be perceived as a conflict of interest related to this body of work.

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