Original Article

Factors Responsible for Fatigue in Rotary Wing Pilots in Indian Air Force

Sqn Ldr PD Navathe

A questionnaire survey was carried out among 161 Rotary wing aircrew comprising a sample population from stations all overthe Indian Air Force. Aircrew were asked to rate 61 fatigue factors on scale of zero to five. A consolidated list of the factors believed to cause fatigue in order of importance was prepared. The results are presented, compared with earlier studies, and the factors discussed with reference to the Indian environment.

Key Words : Hellcopter, Workload.

Introduction

Fatigue has been recognised as an important problem in military aviation for some years now. Though its entity is not well defined, its effects are noticeable and appreciable - indeed in some areas, considerable. The fatigued pilot is likely to be flying at compromised operational efficiency, and is more likely to be involved in accidents / incidents. With their high cockpit workloads and prolonged sortie profiles, helicopter aircrew appear to be at very high risk for fatigue. As such, a complete and thorough understanding of the factors which cause fatigue can help towards the evolution of a direction toward their reduction. This study was, therefore, carried out with the intention of identifying the factors responsible for fatigue.

Material and Methods

Possible causative fatigue factors fall under three main categories

Immediate/Short term workload

- Helicopter factors
- Flight / Operational factors
- Aircrew factors

Duty Day workload

- Duration of work day (incl. time on stand by)
- Quantum of rest available

Long term workload

- Scheduling of work/rest
- Duration and type of duties in Combat areas
- Inter personal and Command relations
- Morale (incl social & emotional factors)

With these as a working premise, a large number of aviators were approached and various factors elucidated and described in terms chosen by the aviators themselves. The sample questionnaires so produced were administered to a small sample population and appropriate modifications made.

The amended questionnaires after repeated modifications were "frozen" and the final questionnaire was printed in requisite number of copies. The final questionnaire consists of 65 questions of which 5 were biographical. There are 61 factors which were to be rated on scale of zero to five. These questionnaires were then circulated by hand to large number of units of IAF. The filled questionnaire were collected and collated using a PC-XT computer.

Since the computer can not distinguish between a zero and a blank (not answered), the rating were changed after receipt to from one to six by adding one to each score. The factorwise scores were totalled for all cases and averaged as per the no. of respondents for each factor. The factor 'Exposure to hostile action' was averaged only for those questionnaires where the respondent had served in battle area. The factors were then prioritised in order of importance.

Results

178 questionnaires were distributed. 161 were received complete in all respects (Fill Rate 90.5%). The complete list of factors prioritised is placed in Table-I.

Graded Specialist (Av Med), IAMTCAF, 28 Wing AF C/o 56 APO.

Table I Factors that Cause Fatigue in Helicopter Aircrew

NO	Factor	Mean Rating
1	Aircraft (Ac) Vibration	5.14286
2	Ac noise	5.10559
3	High Altitude flying (close to heptr limits)	5.06452
4	Time on standby	4.96203
5	Flying in marginal weather	4.83648
6	Duration of duty day	4.79747
7	Cabin temperature (heat load)	4.71257
8	Winching	4.68354
9	Use of helmets	4.64557
10	Exposure to hostile action	4.63087
11	Duties not related to flying	4.62500
12	Instrument flying	4.54037
13	Quality and duration of preceding sleep	4.45000
14	Nap of Earth (NOE) sorties	4.44667
15	Monotony of task	4.44025
16	Seating Comfort	4.36875
17	Duration of duty in combat area	4.29333
18	Flying over the sea	4.29078
19	Helicopter stability	4.28750
20	No of take offs and landings	4.27848
21	Adequacy of ground support	4.23718
22	Low flying	4.23602
23	Hunger and thirst	4.20000
24	Instructional sorties	4.18705
25	Hill Flying	4.18471
26	Night flying	4.09317
27	Communication sorties	4.07453
28	Search and Rescue (SAR) sorties	4.05229
29	Hover	3.95031
30	Effort required for heptr control	3.94410
31	Morale	3.81646
32	Command relationships	3.78205
33	Gunship sorties	3.78125
34	Landing	3.75776
35	Knowledge of purpose of duty	3.69481
36	Nav information	3.66026
37	Restriction due to heavy winter clothing	3.64375
38	Recreational facilities	3.59627
39	Casualty Evacuation sorties	3.56410
40	Recce sorties	3.49045
41	Radio Nav aids	3.45283
42	Radios (Communication)	3.43478
43	Adequacy of clothing	3.38125
44	Duration of leave/duty outside combat area	3.34839
45	Reliability of other crew	3.32075
46	Control feel	3.22360
47	Seat belts/straps	3.22360
48	Social relationships	3.20000
49	Take off	3.17391
50	Instrument display design	3.08075
51	Relationship with fellow personnel	3.07453
52	Limited visibility	3.05000
53	Interest in mission	3.03145
54	Rotor Blade Movement	3.01887
55	Intercom system	3.01863
56	Aircraft Reliability	3.01242
57	Illumination within (at night)	2.88199
58	Relationship with wife/sexual outlet	2.85906
59	Number of engines	2.77070
60	Distortion/Impairment by canopy	2.68750
61	Toxic fumes	2.65409

Discussion

The subjective assessment of fatigue by using questionnaire is well known and globally accepted technique and appears capable of yielding useful information. The technique has been used by Wolf[1], Kogi[2] and Perry[3] to give a measure of individual's opinion on various subjective fatigue factors[4]. From our study, a quick look at the top ten factors (Table I) shows a mixture of aircraft, aircrew, and operational factors. The list is topped by ac vibration and noise (no 1 & 2). This is in contrast to Perry's survey[3] which lists ac vibration at No 10 (Table II). This disparity is possibly explained by the fact that the Western Air Forces use more advanced ac.

Table II Comparative list of fatigue factors in helicopter aircrew

	Present study	Perry et al
1.	Aircraft Vibration	Instrument flying
2.	Aircraft noise	Exposure to hostile action
3.	High altitude flying (close to heptr limits)	Limited visibility
4.	Time on standby	Sleep
5.	Flying in marginal weather	Duration of flying duty day
6.	Duration of duty day	Monotony of mission
7.	Cabin temperature (heat load)	Seating comfort
8.	Winching	Duties not related to flying
9.	Use of helmets	Daily rest
10.	Exposure to hostile action	Ac vibration

Among various types of flying tasks allotted to rotary wing ac, high altitude flying has high fatigue value. The reasons for this in a featureless, high risk, low survivability environment, require no elucidation. The importance lies in understanding that this type of flying cannot be rated on the same scale as others. The yardstick, whether in terms of flying hours or duration of such duties, must be different in these operations. Similarly, flying in marginal weather, placed as factor No 5, has operational significance in terms of aircrew detailing at the unit levels.

Time on stand-by and duration of duty day (No 4 and 6) as fatigue factors merely state a well known fact about helicopter aircrew. It is important only to note that these factors are higher in the list compared to other well known factors like seating comfort etc.

High temperature in the cabin due to the large expanse of transparencies and operational limitations for parking in covered areas etc. pose a serious problem in heptr ops. This factor has been implicated (No 7) as a fatigue factor necessitating consideration during planning and execution of ops in the summer months.

Use of helmets (No 9) finds a place in this list. Though data so far received is inadequate for any definite conclusion, preliminary information received in respect of Army aviators puts this factor on top of the list. Possible reasons for this as brought out during interviews with aviators are:

- The increased heat load.
- The increased fatigue of the neck muscles in holding up the additional weight.
- The helmet is felt to be too heavy.
- Inherent dislike for helmets since helicopter aircrew have been flying without them for long time.

Exposure to hostile action (No 10) was assessed only for aircrew who stated that they had been operating in an actively hostile area (149 respondents). The possible reason for this being so far down the list (as opposed to No 2 in Perry's survey) is the absence of true "under fire" conditions of operation for the ac even in the so called active hostilities regions. In the West, on the other hand, helicopters form an essential and rapidly increasing part of any military action participating right at the Forward Edge of Battle Area (FEBA).

It is not necessary to have a decrease in work output with an associated increase in the subjective feelings of fatigue. One possible explanation for this may well be that the operator needs to exert extra effort to maintain an acceptable level of performance; that is to say, the "biological cost" of that level of performance rises so the ability of the operator to cope with extra task demands is reduced. The operational significance of this cannot be overlooked, since should the fatigued aviator be presented with an emergency situation, his "spare mental capacity" may be inadequate to cope fully with the demands of the situation.

Conclusion

The listing of 'fatiguants' can be of use to personnel in all branches of the Aerospace Environment. For the designers, it is the knowledge that ac vibration and noise reduction moves up from 'desirable' to 'essential'. Planners and commanders can attempt to reduce, within the limits posed by operation (op) requirements, the factors that increase fatigue. To the operators, the pilots, this listing can help to understand that fatigue after a particular type of sortie is normal and that adequate rest, both at work and home, is essential for efficient, and above all, safe flying.

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