Cervicalgia amongst helicopter pilots using helmet mounted devices

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ABSTRACT

Helmet mounted devices (HMD) are increasingly used to enhance operational capabilities of the military pilot. Indian helicopter pilots use Night Vision Goggles (NVG) for undertaking missions, irrespective of the visibility conditions. NVG using pilots have confirmed the issues about added strain on flight performance and increased fatigability during informal interactions. There is a need to understand the altered biomechanics of spine while using NVG, in light of the increased incidence of back pain amongst helicopter pilots. This study analysed the data of a recent questionnaire survey on the incidence of back pain, specifically looking into two variants of Russian helicopters, Mi-8 and Mi-17. The analysis focussed on different aspects of backache, including the incidence, frequency, location, severity and relief measures. A total of 55 helicopter pilots currently flying Mi-8 (n = 31; 56.36%.) or Mi-17 (n = 24; 43.63%), with the mean age of 32.35 years (SD 8.58) and 29.0 years (SD 3.57); and mean flying hours of 2223.0 hours (SD 2071.28) and 3500.0 hours (SD 1141.24), respectively participated in the study. The incidence of back pain was 67.74% (n = 21) and 75.0% (n = 18) for Mi-8 and Mi-17 pilots, respectively. Flying was reportedly the commonest activity precipitating back pain (Mi-8, 90.47%; Mi-17, 77.77%), and ferry sorties were most likely to precipitate back pain (Mi-8, 84.03%; Mi-17, 88.88%). Lower back (Mi-8, 85.71%; Mi-17, 66.66%), neck (Mi-8, 19.04%; Mi-17, 22.22%) and buttocks (Mi-17, 22.22%) were the common locations for the pain; and the severity ranged between discomfort (Mi-17, 50.0%) to moderate pain (Mi-8, 57.14%). Majority did not seek any medical consultation for their malady (Mi-8, 71.42%, Mi-17, 66.66%). The findings were analysed in light of the existing literature on stress factors during helicopter flight viz. seated posture and vibration and reviewed with limited literature on loading effects of HMD on the spine. Based on the analysis, future directions for the prospective studies on altered biomechanical stress and resulting strain of spine while using NVG during flying emerge and recommendations, including the need for preventive measures have been made.

IJASM 2008; 52 (1) : 1-7

Keywords. Helmet mounted devices (HMD); Night Vision Goggles (NVG); Back pain; Backache; Helicopter pilots;

Helmet mounted devices (HMD) are enhancing the operational capabilities of the military pilot. The strategic use of helicopters in operations shall require increased flying commitments at night. This may be either for deployment of troops or search and rescue missions, besides the conventional use. Tactically, considering the prolonged low intensity conflicts in India, helicopters are powerful platform for reconnaissance and neutralisation of the enemy infiltrators. Therefore, the helicopter pilots are increasingly utilising Night Vision Goggles (NVG) for undertaking missions, irrespective of the visibility conditions.

A small study on 21 Swedish helicopter pilots using NVG reported that 48% pilots had neck pain after the sortie [1]. There is an approximate increase of about 70% with the helmet weighing about 1.5 Kg to about 2.6 Kg of the combined weight of the helmet and HMD, including NVG, its counter weights and the battery [2]. An informal survey on back pain among non-pilot aircrew of HH-60G helicopter revealed that they had a common complain of neck pain due to NVG use [2].

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Date of Submission : 6 June 2007

Accepted for publication : 4 Feb 2008

The Indian helicopter pilots are flying with NVG for the past several years. Since the technology is recently acquired and it is in the process of acceptance by pilots, the initial enthusiasm does not reveal any adverse effects either in terms of performance or strain during the use. Informal interactions with NVG using pilots, however, have revealed added strain on flight performance and increased fatigability. Till date there is no field based study on either of these two mentioned aspects.

A recent study on the overall incidence of backache amongst Indian helicopter pilots [3] revealed that 57.57% of them suffer from backache, mostly in the lower back (83.15%), reportedly due to flying (86.31%). Earlier studies [4, 5, 6, 7, 8] suggested that the aetiology of back pain in helicopter pilots is reversible musculo-skeletal strain due to posture and cockpit ergonomics.

Two of the helicopters being flown by pilots participating in the above quoted study are Russian Mi-8 and Mi-17. Both are similar in cockpit ergonomics, with different performance capabilities, and one of them has NVG modified cockpit. Hence the selected data ofthe recent survey [3] pertaining to the pilots of these two helicopters was critically evaluated to find out the location, nature and frequency of the back pain. It must be added that invariably the Mi-8 and Mi-17 pilots do not use helmets during flight. Hence there is a need to understand the altered biomechanics of spine while using NVG, in light of the reported back pain for the two helicopter types. This shall help define the need for requirement of prospective study on stress and strain of the spine amongst helicopter pilots using HMD.

Material and Methods

This study is based on the available data of a recent questionnaire survey on backache [3]. This was based on an earlier validated questionnaire [8]. The questionnaire included demographic, flying and lifestyle related inputs, besides focussing on different aspects of backache, including the incidence, frequency, location, severity and measures sought for relief from the pain.

The questionnaire was posted to the Medical authorities of the helicopter base operating Mi-8 and Mi-17 helicopter. The structured questionnaire was, in turn, given to the available pilots of the helicopter units and was posted back to the authors within a period of 45 to 60 days.

The analysis in the present survey is limited to descriptive statistics to plan prospective studies on spinal strain amongst NVG using helicopter pilots.

Results

The results of this study are based on the questionnaire feedback from a total of 55 helicopter pilots currently flying Mi-8 (n = 31; 56.36%.) or Mi-17 (n = 24; 43.63%). The mean age of the respondents was 32.35 years (SD 8.58) and 29.0 years (SD 3.57) for Mi-8 and Mi-17, respectively. The respective mean flying hours were 2223.0 hours (SD 2071.28) and 3500.0 hours (SD 1141.24) for Mi-8 and Mi-17 helicopter, respectively.

The overall incidence of back pain in Mi-8 and Mi-17 operating pilots was 67.74% (n = 21) and 75.0% (n = 18), respectively (Figure 1). The remaining pilots who did not report backache (n = 16) did not respond to the remaining questionnaire. Hence the results hereafter are based on the feedback of the pilots (n = 39) reportedly having complaints of backache.

On one hand, 33.33% Mi-8 pilots reportedly had pain almost every day and 23.8% had it once a week and 19.04% occasionally; on the other,

27.77% of Mi-17 pilots only had occasional complaint of back pain and 22.22% each had pain only once in a week or even once in a quarter (Figure 2).

The commonest activity precipitating back pain was flying (Mi-8, n = 19, 90.47%; Mi-17, n = 14, 77.77%) (Figure 3). The type of sorties most notorious to precipitate back pain were the ferry or cross-country sorties (Mi-8, 84.03%; Mi-17, 88.88%) (Table I). Majority of Mi-17 pilots (61.11%) reported that the pain was likely to be precipitated after flying for more than two hours, as also reported by Mi-8 pilots (42.85%) but an equal percentage of Mi-8 pilots reported onset of pain after flying for an hour.

The commonest location of the pain was the lower back (Mi-8, 85.71%; Mi-17, 66.66%) with neck being the second common location ((Mi-8, 19.04%; Mi-17, 22.22%), as also the buttocks for Mi-17 pilots (22.22%) (Table III). Majority of Mi-8 pilots (57.14%) complained of pain being moderate in severity, whereas 50.0% Mi-17 pilots reported only discomfort and another 44.44% had pain of moderate severity (Table IV).

Majority of the respondents (Mi-8, 42.85%; Mi-17, 38.88%) reported relief from the pain

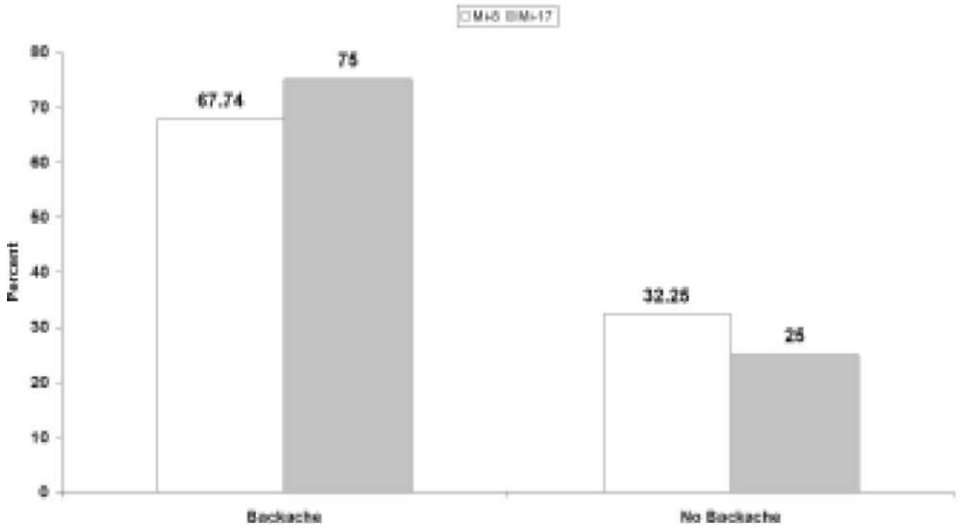

Figure 1: Incidence of backache among Mi-8 and Mi-17 Pilots (Percent)

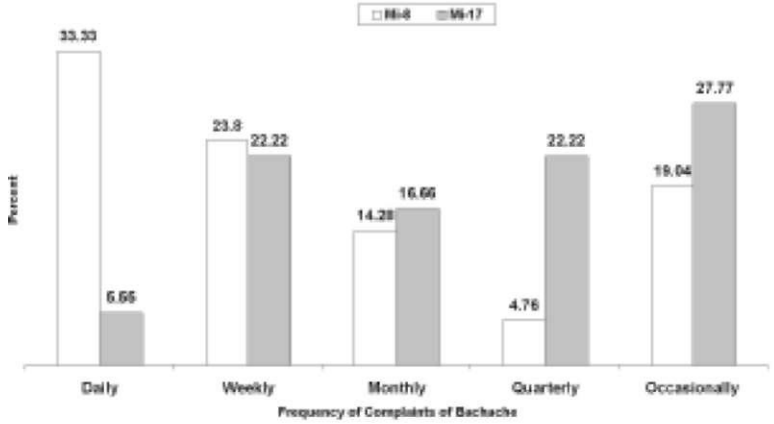

Figure 2: Frequency of backache among Mi-8 and Mi-17 Pilots (Percent)

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Figure 3: Activity precipitation backache in Mi-8 and Mi-17 Pilots (Number)

Table I: Type of sortie precipitating backache

	Ferry/Cross Country (n)	Instrument Flying (n)	SAR (n)	Night Flying (n)
Mi-8	17 (84.03%)	6 (28.57%)	3 (14.28%)	8 (38.09%)
Mi-17	16 (88.88%)	2 (11.11%)	1 (5.55%)	1 (5.55%)

Table II: Duration of sortie precipitating backache

	Within Half an Hour	Between 1 to 2 Hours	More than 2 hours
Mi-8	1 (4.76%)	9 (42.85%)	9 (42.85%)
Mi-17	0	6 (33.33%)	11 (61.11%)

Table III: Location of pain in the back

	Neck	Upper Torso	Lower Back	Buttocks	Non-specific
Mi-8	4 (19.04%)	3 (14.28%)	18 (85.71%)	2 (9.52%)	2 (9.52%)
Mi-17	4 (22.22%)	3 (16.66%)	12 (66.66%)	4 (22.22%)	0

Table IV: Severity of back pain

	Discomfort	Mild Pain	Moderate Pain	Severe Pain	Incapacitating
Mi-8	7 (33.33%)	4 (19.04%)	12 (57.14%)	1 (4.76%)	0
Mi-17	9 (50.0%)	5 (27.77%)	8 (44.44%)	1 (5.55%)	0

Table V: Duration for recovery from back pain

	Less than 2 Hr	2 to 6 Hr	Up to 24 Hr	More than 24 Hr
Mi-8	8 (38.09%)	9 (42.85%)	1 (4.76%)	2 (9.52%)
Mi-17	6 (33.33%)	7 (38.88%)	4 (22.22%)	1 (5.55%)

Table VI: Mode of recovery from back pain

	Spontaneous	Stretching Exercise	Bed rest	Rest on Hard Bed	Self administered painkiller	Medication
Mi-8	9 (42.85%)	10 (47.61%)	3 (14.28%)	8 (38.09%)	0	0
Mi-17	6 (33.33%)	6 (33.33%)	3 (16.66%)	11 (61.11%)	1 (5.55%)	0

between 2 to 6 hours after the sortie; and others (Mi-8, 38.09%; Mi-17, 33.33%) found relief within 2 hours of landing (Table V). Measure to obtain relief from the pain included either taking rest on hard bed (Mi-17, 61.11%) or some spinal stretching exercise after the sortie (Mi-8. 47.16%). Despite many of the pilots complaining of back pain, their response to a pointed question about seeking medical attention in the past 12 months revealed that only 5 (Mi-8, 23.80%) and 1 (Mi-17, 5.55%) sought medical attention only once, whereas 15 (Mi-8, 71.42%) and 12 (Mi-17, 66.66%) each affirmed that they never sought any medical help.

Discussion

This study purports to specifically analyse the data of a questionnaire survey on the incidence of backache pertaining to pilots flying Mi-8 and Mi-17 helicopters. The analysis focussed on the nature of back pain reported by the pilots. This is required to define the likely pattern of strain on the back while using HMD during flight. This shall help plan and propose prospective studies on altered biomechanical strain and resulting stress on the spine while using NVG during flight and to define the preventive measures.

An overall incidence of back pain among Mi-8 and Mi-17 pilots was 67.74% and 75.0%, respectively (Figure 1). The frequency of pain varied from almost every day (Mi-8, 33.33%) to only occasional complaints (Mi-17, 27.77%) (Figure 2). Flying was reportedly the commonest activity precipitating back pain (Mi-8, 90.47%; Mi-17, 77.77%) (Figure 3). Sorties like ferry or cross¬ country were most notorious to precipitate back pain (Mi-8, 84.03%; Mi-17, 88.88%) (Table I); thus the prolonged duration of sortie was likely to cause back pain (Table II).

Lower back (Mi-8, 85.71%; Mi-17, 66.66%), neck (Mi-8, 19.04%; Mi-17, 22.22%) and buttocks (Mi-17, 22.22%) were the common locations for the pain (Table III). The severity of pain was between discomfort (Mi-17, 50.0%) to moderate (Mi-8, 57.14%) in severity (Table IV). The pain was relieved 2 to 6 hours after the sortie (Mi-8, 42.85%; Mi-17, 38.88%) (Table V) and required rest on hard bed (Mi-17, 61.11%) or some stretching exercise (Mi-8. 47.16%). Majority ofthe respondents did not seek any medical consultation for their malady (Mi-8, 71.42%, Mi-17, 66.66%).

While the the results of this study confirm to the existing body of work on back pain among helicopter pilots [4-8], an incisive look keeping the likely changes in the load bearing on the spine while using HMD to accomplish missions at night, with undefined hours on duty and resulting altered circadian rhythm for the pilots, shall definitely affect the performance capabilities and mission preparedness of the pilots. Therefore, there is a need to study each of the factors affecting mental workload and performance to keep the pilots mentally agile and fit for mission accomplishment. This paper shall hereafter focus only on the need to study biomechanics of the back, especially the neck, to define strain and stress pattern while using

HMD.

Delahaye et al reported that helicopter pilots complain of aching at the nape of the neck, due to extreme movements of the head, which could worsen with the protective helmet [4]. It has been widely accepted that the back pain among helicopter pilots is classically caused by combination of twisted seated posture due to cockpit control layout, especially the collective; and the vibrations resulting from the main rotor of the frequency range between 3 to 7 Hz, which matches with that of the upper torso of principal resonance frequency of 5 Hz.

de Olivieara and Nadal suggested that the most important factor in the spine related disability could be due to the cyclic mechanical load imposed by the vibration [9]. They quoted an earlier study about the correlation between neck and shoulder muscle load with increased susceptibility to problems on exposure to whole-body vibration. The load and problems aggravate further while working in twisted position compared from the neutral, as is the predicament of the helicopter pilots.

A higher incidence of spine related disorders among helicopter pilots may therefore be because of the vibration leading to cumulative load on the spine. The altered load conditions due to increased weight of HMD and the whole-body vibration transmissibility must be correlated with the spinal degenerative changes and its location amongst helicopter pilots. A study of musculoskeletal disabilities among aircrew (n = 232) at an Indian evaluation centre reported that 58.5% of helicopter aircrew had spinal musculoskeletal disability, compared to 53.2% and 46.9% in fighter and transport aircrew, respectively [10]. The majority of aircrew (38%, n = 46) had MRI confirmed degenerative disease of the disk. 80.4% had degenerative disease of the lumbo-sacral disk (50% each at L4/L5 and L5/S1 level) and 19.5% had cervical disk degeneration (maximum 78% at C5/C6 level). The percentage of cervical degeneration must be viewed with concern with HMD likely to affect the load on the spine causing chronic strain.

Therefore there is a need to undertake extensive whole-body vibration studies with different HMD used by Indian helicopter pilots. This shall help define the stress loading at different levels of spine. In addition, the Spatial Disorientation simulator at the Institute of Aerospace Medicine can be utilised for simulated long duration cross-country sorties with HMD to study the musculo-skeletal fatigue of neck and upper torso. The same studies can, then, be extended to actual operations to study the strain effects of combination of in-flight stresses on the spine. The resulting body of work can finally help define the preventive strategy for safe operations with HMD. This includes work-rest and physical exercise schedule of the squadron pilots. Physical exercise shall aim at toning up ofthe spinal especially neck muscles, as part of the pilots' daily routine to prevent long term adverse effects of the helicopter flying with HMD. It is suggested that mandatory MRI scan at regular intervals must be planned for helicopter pilots based on cumulative flying hours. This shall help visualise early non-symptomatic spinal degenerative changes, before it compromises pilots' physical well-being and flying efficiency.

Conclusion

An analysis focussing on the nature of back pain reported by the pilots flying Mi-8 and Mi-17 helicopters was undertaken to define the likely pattern of strain on the back while using HMD during flight. The findings suggest that neck remains a potential area of concern in view of the flight conditions and the altered weight on the head with HMD. Recommendations for prospective studies

on altered biomechanical stress and resulting strain of spine while using NVG during flying and the preventive measures have been made.

Conflicts of interest: None identified.

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