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A REVIEW OF THE PILOT BACKACHE PROBLEM IN THE CH113 LABRADOR HELICOPTER

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ABSTRACT

In response to an Unsatisfactory Condition Report, complaints of back pain and discomfort induced by the pilots' seat of the CH113 Labrador helicopter were investigated. Several published reports dealing with the problem are reviewed and summarized in terms of incidence and prevalence rates, frequency, intensity, duration, location and time to pain onset. A questionnaire was developed and distributed to CH113 Labrador helicopter pilots in order to determine how closely the backache characteristics of the pilots match the characteristics reported by the general population. In addition, an evaluation of the size and shape of the Labrador seat was conducted and results were compared to published seat design guidelines and recommendations. Questionnaire results indicate that the typical backache reported by Labrador pilots is similar to the backache reported by other helicopter pilots. It is usually a dull pain in the lumbar area, most often experienced during flight and usually lasting after the mission ends. Subjective results also indicate that backache may be negatively correlated with regular exercise. Based on the symptoms identified in the questionnaire and the causes identified by other investigators, design principles for an improved seat incorporating an inflatable lumbar support and a more effective load bearing seat cushion were established.

INTRODUCTION

In response to an Unacceptable Condition Report (UCR) filed by 442 Transport and Rescue squadron, DCIEM was asked by NDHQ to provide assistance in investigating the problem of helicopter pilot backache in the CH113 Labrador helicopter. The UCR stated that over the duration of a typical search and rescue (SAR) flight, pilots were developing back discomfort sufficiently serious to pose a flight hazard. Investigation of the problem revealed two major aspects; the comfort the seat provided to the pilot during routine flight operations and, the protection the seat provided to the pilot during emergency landings and crashes. It was concluded that the first aspect, comfort, could be satisfactorily addressed by the DCIEM Human Engineering Section. The application of fundamental ergonomic seating principles and design guidelines to new cushioning should provide the pilot with improved support and put him in a posture conducive to the effective operation of the helicopter. The second aspect, crashworthiness, requires a much more extensive research program. DCIEM has the facilities and personnel required for this, but results and recommendations could not be expected within the time frame of the response to the UCR.

This report outlines the research effort undertaken to improve the comfort of the pilots. The objectives of the report are:

1) to review the findings of previous research on helicopter backache;

2) to review the characteristics of back problems in Labrador pilots;

3) to evaluate the size and shape of the current Labrador seat; and

4) to develop recommendations for improvements to the seat cushion in the CH113 Labrador helicopter.

PART 1: REVIEW OF LITERATURE

The problem of backache has been well documented by several authors and agencies, with the most recent overview of the literature being provided by Bowden (1). This report concentrates only on the literature most relevant to helicopter related backache. The areas of interest are: the incidence of backache in various populations, the symptoms and time course of backache in helicopter pilots and, the causes of helicopter induced backache.

While the prevelance of backache is difficult to establish at any given time, considerable work has been conducted to determine the incidence of backache. Reported incidence rates, i.e., the percentages of people in different populations having suffered backache at some time in their life, vary considerably depending on the population under study and the definition of backache used. However, the incidence rate of 50 - 60% for an industrialized country, reported by Andersson (2), is generally accepted. Andersson (2) also provides support for the commonly held belief that backache is the most common cause of disability and lost productivity in the urban workforce. Dealing specifically with helicopter pilots, reports vary between an incidence rate of slightly under 50% (3) to over 95% (4), depending on the type of helicopter, the type of mission and the experience of the pilots.

The type of pain reported by helicopter aircrew seems to be much more specific than that reported by the general population. The pain of helicopter aircrew tends to be more regular and is highly associated with flight duties (5). The aviator often cannot identify any particular event that initiates pain, except flying. Delahaye et al (4) report that the most common symptom of helicopter induced backache is a dull ache in the lower back (lumbar region). This ache is often associated with a tired feeling that may become debilitating if the pilot continues to fly. Very few pilots report pain in the upper back (thoracic region) or in the shoulders and neck. Once the pain begins in flight, it may increase in intensity throughout the flight or it may reach a certain level and

remain stable. It is usually not relieved by the minimal shifting of position that is possible in the cockpit. Relief is not obtained until the flight is terminated and the pilot's posture is radically altered. Some pilots report a chronic pain with episodes of acute pain for several days after the flight while engaging in activities other than flying. It appears that once a pilot has experienced back problems, he is more susceptible to experience recurring backaches.

The backache is most likely to appear in the pilot during a mission, after he has spent a certain amount of time at the controls. The following threshold values for the onset of back pain have been suggested (4).

a) 500 total rotary wing hours

b) 30 - 40 hours per month

c) 3 - 4 hours per day

d) 1.5 hours of continuous flight

It is important to note that these values represent general trends and should not be interpreted as strict boundaries. For example, some pilots report back problems after as little as 20 hours of total flight time and other pilots report no backache after as many as 5000 hours.

Numerous causes of backaches have been identified, with different authors suggesting different causes as primary. These include:

a) the posture assumed by the pilot;

b) the length of time the pilot must maintain the posture;

c) the poor design of the seat; and

d) the vibration of the aircraft.

In terms of the posture, the four sources of poor posture that have been judged to contribute the most to the pilots' discomfort are:

a) the asymmetry of the upper body;

b) the extension of the legs;

c) the forward slouch of the shoulders; and

d) the improper bending of the lower back.

The asymmetry between the arms, with the right arm resting on the right thigh and grasping the cyclic control located between the knees and the left arm extended past the outside of the left thigh to grasp the collective control, places an uneven load on the muscles of the back. Over time, the uneven muscular tension leads to unnatural positions of the back. The extension of both legs to reach the rudder pedals tends to immobilize the pelvis area and can, over time, restrict the circulation and neural transmission in the lower body. The forward slouch of the pilots' shoulders is caused by the need to reach the controls, resulting in the characteristic "helicopter hunch" of pilots. This hunch is further aggravated by the unnatural outward bending (kyphosis) of the lower spine. Kyphosis drastically reduces the load carrying ability of the spine and can unduly stress the intervertebral discs, possibly leading to injury to the disc. Kyphosis is increased by the pilots' need to lean forward off the seat back in order to reach the aircraft controls. Ideally, the lower back should have an inward bending (lordosis). With lordosis, the spine is better able to support the weight of the upper body, thereby reducing the stress on the muscles of the back.

The asymmetric, legs extended, slouched, kyphotic posture of the helicopter pilot puts his body in a biomechanically poor position that places excessive strain on the spine and postural muscles. In general, improvements to that posture would be possible only through a complete alteration in the helicopter control layout; an expensive, time-consuming and difficult process. However, some improvements to the the kyphotic posture of the pilot could be accomplished by providing the pilot with a properly positioned

lumbar support.

The length of time the helicopter pilot must maintain his posture is a second quoted factor in discomfort. Since the pilot uses all his limbs in the operation of the aircraft, he cannot shift his seating position to any great extent. In a typical SAR mission, the pilot maintains the same position for 4 - 5 hours. Normally, seated humans adjust their position quite frequently in order the redistribute the stress on the postural muscles (1). Without redistribution, sustained muscular tension leads to local muscle fatigue. Fatigued muscles may be less able to protect the musculo-skeletal system from the stresses of flying, and therefore, may make injury more likely. Given a good seating position, maintaining the same posture for extended periods may not be as critical. However, given the very poor posture of the helicopter pilot, it becomes an important factor.

The third often cited cause of backache, poor seat design, is common to many helicopters. The lack of adjustability for seat height, the improper angle of the seat back and the lack of adequate lumbar and buttock support are the most common criticisms of the seats. The lack of height adjustment forces taller pilots to slouch and shorter pilots to extend their posture in order to reach controls or gain adequate external vision. The improper seat back angle is cited as a cause in increasing the lumbar kyphosis if the seat back is too close to vertical. Alternately, if the seat back is angled too far back, it does not provide adequate back support, thereby increasing the load the postural muscles of the back must support. A second factor of poor seat design, insufficient seat pan cushioning, results in the concentration of body weight on the bones of the buttocks, the ischial tuberosities. This concentration of weight leads to discomfort in the buttocks. Ideally, the weight of the body should be spread over a larger area of the buttocks and upper thigh.

Vibration is often cited as a causal factor of helicopter back problems. To date, the evidence supporting vibration as a causal factor has been largely subjective and theoreti-

cal (3). Vibration data collected for several helicopters have shown the major components of vibration are at or near the resonant frequencies of the spinal system (4). Consequently, many authors have speculated that recurring long term exposure to helicopter vibration is harmful to the spine. However, the effects of chronic, intermittent exposure to whole-body vibration are not well quantified. Therefore, the role of vibration in helicopter backache is uncertain. An interesting argument against vibration as a causal factor in helicopter pilot backache has been published by Shanahan and Reading (5). These researchers found that backache could be produced in pilots just as easily by having them seated in a nonvibrating simulator and performing a control task as by having them performing the same control task when the simulator was vibrating at frequencies and amplitudes representative of a helicopter. These results indicate that vibration may not be a primary causal factor in backache.

In summary, the literature on helicopter pilot backache identifies the causes of the problem as the posture of the pilot, the length of time the pilot must hold the posture, the poor support the seat provides and, possibly, the vibration of the aircraft. Although individual studies differed slightly in exact details, there was sufficient agreement among the studies to indicate the characteristics, severity and complexity of the problem. The literature indicates that the majority of pilots will experience a backache that is a dull pain in the lower back that is most often experienced during flight and does not stop until some time after the mission ends. The backache is usually severe enough to cause a minor distraction, but is rarely severe enough to impair flight duties.

PART 2: BACKACHE IN CF LABRADOR PILOTS

Given the general picture of helicopter pilot backache outlined above, this investigation was aimed at verifying the type of backache reported by the Labrador pilots, and investigating the characteristics of the Labrador pilot seat.

METHODS

To study the nature of backache the backache of Labrador pilots, a questionnaire was developed and distributed to 26 active CF Labrador pilots in early 1985. The pilots canvassed were from 442 squadron in Comox B.C., and 413 squadron in Summerside P.E.I. The questionnaire, shown in Appendix A, was designed to document the characteristics of back problems in the pilot population. The development of the questionnaire drew concepts and constructs from several sources. It included an analysis of the flight experience of the pilots, the prevalence of backache, the frequency, intensity and duration of backaches, the time to onset of backache, the location of the backache and the physical activity patterns of the pilots. Pilots completed the questionnaire independently in order to minimize any group effects that may have emerged through discussion.

To investigate the adequacy of the pilot seat, the seat was evaluated against established ergonomic design guidelines for seating in general (6), against guidelines for military seating (7), and against design criteria for military helicopter seats (8). The evaluation was concerned with seat adjustability, seat height, seat back angle and reach distances to the rudder pedals. The evaluation was conducted using a seat mounted in an operational Labrador of 442 squadron

RESULTS

Table 1 presents a summary of the results from the questionnaire data.

Table 1. Summary of Questionnaire Results

Sample	Factor	# of Responses	% of Responses	Characteristic
All Pilots n = 26	pilot profile	26	100	average 2118 rotary hours (range 130-5200) average 30 hours a month (range 20-50) average 2.9 hour mission length
	incidence	15	58	have had back discomfort
	prevalence	13	50	had backache in the last year
	miscellaneous	8	31	exercised daily
		21	81	exercised at least twice a week
		14	54	often leaned forward off the seat back
		1	4	felt Labrador seat was comfortable
Pilots with Backache n = 15	pilot profile	15	100	average 1987 rotary hours (range 200-5000)
	frequency	6	40	have backaches only when flying
		7	47	have backaches at least weekly
		11	74	have backaches at least monthly
	intensity	12	80	have a dull pain
		10	67	have pain of at least moderate intensity
		10	67	pain occasionally distracts attention
		14	93	pain never limits the flight profiles flown
	onset time	14	93	have gradual onset of pain
		10	67	have backache within 2 hrs of flight
	duration	9	60	have pain after the mission
		4	27	have pain at least one day after the mission
	location	14	93	have pain in the lower back
		1	7	have pain in the upper back
	miscellaneous	2	13	exercised daily
		12	80	exercised at least twice a week
		8	53	have sought professional treatment
		10	67	had no backache until 300 hrs total time
		8	53	often leaned forward off the seat back
Pilots without Backache n=11	pilot profile	11	100	average 2208 rotary hours (range 130-5200)
	miscellaneous	6	55	exercised daily
		9	82	exercised at least twice a week
		6	55	often leaned forward off the seat back

The table indicates quite a wide range in terms of pilot experience, with the average pilot being on his second or third flying posting with 2118 hours. The table indicates that the incidence rate, the percentage of pilots who have experienced backache, is 58% among Labrador pilots. The prevalence rate, defined here as the percentage of pilots experiencing backache within the past year, is 50%. It appears that the vast majority of pilots are quite active physically, with over 80% reporting regular exercise at least twice a week. It is interesting to note that only one pilot felt that the Labrador seat was comfortable. He reported no back pain after 850 total rotary wing hours.

The results allow a profile of the typical Labrador pilot backache to be drawn. It is a dull pain of moderate intensity in the lower back. It is most often experienced during flight duties, with pain starting within the first two hours. It always lasts the remainder of the mission, often lasts for hours after the mission and sometimes lasts for days after the mission. Although the pain occasionally distracts the pilots' attention during flight, it is seldom so intense as to restrict the flight profiles flown.

The results indicate that pilots without backache have higher average rotary hours than those with backache. This is contrary to what one would expect. 55% of pilots without backache exercised daily in contrast to a low 13% of pilots with backache.

The majority of the pilots reported that their back problem was serious enough to seek professional treatment, most often from their flight surgeon. It is interesting to note that only one pilot had sought treatment from a chiropractor. The two most common methods of relief were rest and massage. One pilot had corrective back surgery for a problem caused by an acute accident unrelated to flying duties. He has returned to active flying and reports he no longer has backaches in flight.

Table 2. Comparison of the CH113 Labrador seat with published guidelines.

Seat Dimension	Labrador Seat	Penero and Zelnick (6)	Mil Std 1472C (7)	AFSC DH2-2
seat pan width (cm)	46	38.1		
depth (cm)	35.5	40.6		35.6
height (cm)	30.5	42	45.5	26.6
angle (deg)	5	0 - 15		5
seat back width (cm)	46	30 -35		
height (cm)	61	48		57.6
angle (deg)	11	5 - 15	10 - 15	13
fore/aft adjust (cm)	20			7.6
vertical adjust (cm)	13		7.5	12.7
pedal-seat distance (cm)	75 - 95			82
rudder adjust (cm)	20			15.3

Table 2 presents the comparison of the configuration of the Labrador seat with published guidelines and recommendations. The table indicates that the Labrador seat meets all recommendations in seat pan width and angle, seat back width and height, fore aft adjustment, vertical adjustment, rudder pedal to seat distance and rudder pedal adjustment. The Labrador seat does not meet all recommendations in seat pan depth and height or seat back angle. However, of these, seat pan depth and height meet the recommendations for military helicopter seats, with seat back angle being very close to recommendations [AFSC DH 2-2 (8)]. In summary, by itself the current Labrador seat conforms to recommended specifications in almost all dimensions and should provide the pilot with an adequate seating platform.

DISCUSSION

The questionnaire results indicate the characteristics of back problems in Labrador pilots. The obtained incidence rate of 58% was in the lower end of the range reported in other helicopter backache studies (3,4). This is surprising, considering that the Labrador pilots often fly long SAR missions (over 5 hours) in a seat that was designed for short term use. The first of two possible explanations for this finding is that the flying hours of the average Labrador pilot were below the hours a month threshold identified on page 3 , and very close to the hours a day threshold. Therefore, it is conceivable that the average pilot is not exposed to sufficient recurring stress to produce backache. Of the pilots reporting daily and monthly hours over the thresholds, the incidence rate increased slightly to 62%. The second possible factor in the low incidence rate was the average amount of physical activity reported by the pilots. It is well known that a strong, flexible musculature is more able to withstand physical stress and trauma. The high percentage of pilots getting physical activity at least twice a week is indicative of a physically fit population, therefore a population able to withstand the stress of flight. It is conceivable that if the pilots were less active, the obtained incidence rate would be higher.

The obtained prevalence rate indicates that of the 15 pilots who have ever had backache, 11 reported discomfort at least monthly, and 7 reported backache at least weekly. This supports the assertion that once a helicopter pilot experiences back problems, he is prone to experience recurring problems.

The symptoms of the typical Labrador pilot backache can be characterized in terms of intensity, rate of onset, duration and location. The pilots reported a dull pain intense enough to occasionally distract their attention but very rarely intense enough to limit the flight profiles flown. One area that the questionnaire did not address is whether the pilots felt the intensity of their backaches affected their flying performance. However, the UCR did indicate that several pilots felt that their backache did pose a hazard to

flight safety.

With rate of onset, the pilots reported their backache would usually start within the first two hours of flight. The pain would increase gradually until it reached a a certain level and then plateau. The pain would not start suddenly as the result of one particular movement of action by the pilot. Once started, the backache lasted the duration of the mission, but usually went away within hours after the mission ended. However, a substantial proportion of the pilots (27%) reported the pain lasting at least one day after the mission.

The lower back was overwhelmingly the problem area for pilot backaches. Only one pilot reported pain in the upper back. This is in agreement with previously reported studies. One probable factor for this lumbar pain is the unnatural kyphotic bending of the spine. It appears logical that if the spine were given the proper lordotic curve through a lumbar support, many of these lumbar pains could be alleviated. This lumbar support would have to be adjustable in order to accommodate the range of different pilot sizes and back shapes (3). Although not specifically addressed by the questionnaire, many pilots also identified pain in the buttocks as being common. They indicated in general conversations that the current seat cushion tended to "bottom out", thereby concentrating the entire body weight on the bones of the buttock. This led to reports of pain. It appears that any new seat cushioning should incorporate a way to spread the body weight over a larger surface area of the buttocks and upper thigh. Pressure and heat sensitive foams that conform over time to body contours are available to accomplish this.

In comparing the pilots with backache to those without, two points are relevant. First, the pilots with backache had lower average total rotary hours. If total flight time is a factor in aggravating backache, one would normally expect them to have higher average hours. However, it should be noted that the difference between groups is quite small (10%) and is based on relatively few responses (11). Second, of the pilots with no

backache, 55% reported that they exercised daily. This percentage dropped to 13 in the group of pilots reporting backache. This, coupled with the finding that pilots without backache had higher average rotary hours, might indicate that daily exercise is beneficial to the pilots and may help delay the onset of backache. It is the author's contention that a regular exercise programme specifically aimed at improving the strength, endurance and flexibility of the lower back and abdomen would decrease the incidence rate of backache substantially.

The evaluation of the size and shape of the current Labrador seat was accomplished through a comparison of the dimensions of the Labrador seat with published standards and guidelines. The comparison indicates that the size of the seat is adequate and should not be a causal factor in backache. It provides a seat pan and seat back of adequate width, depth and height and provides sufficient adjustability to accomodate various pilot sizes. However, none of the guidelines or standards mentioned the shape of the seat cushion. More than half of the pilots (14 of 26) indicated that they receive no back support from the seat since they often lean forward and off the seat back when flying. This increases the unnatural kyphotic curve of the lumbar spine which in turn increases the muscular effort in the lumbar area required to support and stabilize the upper body. Of those 14 pilots, 8, or 58%, reported backache. This percentage is identical to that obtained in the pilots who indicated they seldom leaned forward off the seat back. This indicates that leaning forward and increasing the kyphosis may not, by itself, cause a higher incidence of backache. Based on the numerous reports of back pain and observations of pilot posture, it appears that the current seat cushion does not provide the pilot with the back support required to maintain a desirable flying posture. Providing more back support should be the major aim of any improvements to the seat arrangement.

RECOMMENDATIONS

In developing recommendations for an improved seat cushion, two areas are of primary concern. First, a seat cushion incorporating a lumbar support would improve the pilot's posture by inducing a slight lordotic curve to the lower spine and helping to support and stabilize the upper body. If an adjustable lumbar support was used, the amount of back support given to the pilot should be altered to suit his particular postural preferences. Also, an adjustable lumbar support could allow the pilot to alter his position somewhat throughout the mission. This altering of position would have beneficial physiological and psychological effects. One method of providing the required adjustability would be to incorporate an inflatable bladder in the lower part of the seat back. Adjustability would be provided by increasing and decreasing the air pressure in the bladder, thereby increasing and decreasing the size of the bladder. Therefore, it is recommended that additional back support be provided to the pilot through the use of an inflatable lumbar support.

Second, the concentration of weight on the bones of the buttocks caused by the "bottoming out" of the current seat cushion should be relieved. This could be done by using a seat cushion that distributes the pilots' weight over a larger area of the buttocks and upper thigh. Such a cushioning arrangement is possible through the use of heat and pressure sensitive foam. Therefore, it is recommended that a seat cushion that supports the pilot more effectively be provided.

CONCLUSIONS

This investigation has demonstrated that the backache problem in CH113 Labrador helicopter pilots is similar to the back pain reported in other helicopter pilot populations. It is prevalent in the majority of pilots, is almost exclusively in the lower back and buttocks and can vary in intensity from a dull ache to an intense pain with varying degrees of effect on pilot performance. Although initial backaches may be irregular and sporadic, the recurring stress of helicopter flight makes backache a recurring problem.

The size and shape of the current seat used in the Labrador conforms quite closely to published design guidelines and standards. However, the shape of the seat cushion does not appear to provide the pilot with sufficient buttock and back support to place him a good flying posture.

It is recommended that the current seat be altered in two ways. First, additional back support from an inflatable lumbar support should be provided to the pilot. Second, a seat pan cushion made from pressure and heat sensitive foam should be provided to distribute the body weight over a larger surface area of the buttocks and upper thigh.

It is recommended that a regular exercise program aimed at improving the strength, endurance and flexibility of the lower back and abdomen be made available to pilots.

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APPENDIX A

Labrador Seating Questionnaire

DCIEM is currently working to improve the seating used in Canadian Forces helicopters. An important aspect of this work involves canvassing current pilots to get their opinions and ideas about the severity of the problems and what can be done to solve them. The information that you give is being used by DCIEM personnel only and will be kept strictly confidential. The questionnaire should only take about 10 minutes to complete and your name is not required. Your time and efforts are greatly appreciated and should result in an improved seat for CF helicopters.

1. What type of aircraft are you currently flying? _____

2. How many hours do you have on this type? _____

3. What other types of aircraft have you flown ? _____

4. How many rotary wing hours do you have? _____

5. How many fixed wing hours do you have? _____

6. What is your present average flying time per day _____

   per week _____

   per month _____

7. What is your average mission length? _____ hrs

8. How often do you get physical activity?

   _____ daily _____ 2-3 per week _____ once a week _____ seldom

9. What activity do you get? _____ walking _____ running _____ cycling

   _____ skating _____ racquet sports _____ personal exercising

   _____ other

10. Do you think the Labrador seats, in general, are

    _____ comfortable _____ not too bad _____ uncomfortable

11. During flights, do you keep the shoulder straps locked?

_____ always _____ often _____ seldom _____ rarely

12. During flights, do you sit forward in the seat and off the backrest?

_____ always _____ often _____ seldom _____ rarely

What improvements would you like to see made to the Labrador seat?

13. Which of the following statements best describes you?

a) I consider my back to be strong and healthy since it very seldom gives me any discomfort. _____

b) My back is not as healthy as it could be since it does give me discomfort. _____

If you answered (a) to the last question, please return the questionnaire to the person who gave it to you.

If you answered (b), please continue the questionnaire.

14. At what age did you first experienced backache or pain ? _____

15. Have you ever had an accident involving your back? _____ yes _____ no

16. How frequent are your backaches?

_____ less than 1/yr _____ 1/yr _____ 1/month _____1/week _____1/day

17. Where is your backache usually located?

_____ upper back _____ mid back _____ lower back _____ it varies

18. Is the onset of the pain usually _____ gradual or _____ sudden?

19. Once a backache has developed, how long does it usually last?

_____ weeks _____ days _____ hours _____ minutes

20. Describe the discomfort. _____ dull _____ sharp _____ burning

_____ mild _____ moderate _____ severe _____ debilitating

21. Have you ever sought professional treatment? _____ yes __ no

22. If yes, from whom? _____ your flight surgeon _____ another doctor

_____ a specialist _____ a chiropractor _____ other

23. Which of the following forms of treatment, if any, have helped you?

_____ rest ___ heat _____ medicines _____ surgery _____ massage

_____ exercise _____ manipulation _____ stretching _____ other

24. Have you experienced any backache while flying in the past year?

_____ yes _____ no

25. How often do you experience backache during a mission?

_____ always _____ nearly always _____ occasionally _____ seldom

26. During missions, where is your backache usually located?

_____ upper back _____ mid back _____ lower back _____ it varies

27. How long do you feel you can fly continuously before your backache begins?

_____ 15 min _____ 30 min _____ 1 hr _____ 2 hrs _____ 2+ hrs

28. Once started, does the pain _____ persist or does it _____ go away?

29. After how many total helicopter hours did your backaches begin?

_____ under 50 _____ 50-100 _____ 100-300 _____ 300-500 _____ 500+

30. During leave periods when you are not flying, are your backaches

_____ more frequent _____ the same _____ less frequent _____ never

31. Does your backache impair your concentration during a flight ?

_____ often _____ occasionally _____ never

32. Does your backache distract your attention during a flight?

_____ often _____ occasionally _____ never

33. Does your backache limit the flight profiles you fly?

_____ often _____ occasionally _____ never

34. Which of the following statements best describes you?

a) My back problems are related to my flying duties and they usually go away very shortly after the mission. _____

b) My back problems usually persist after the end of the mission and interfere with many of my other activities. _____

If you answered (a) to the last question, please return the questionnaire to the person who gave it to you.

If you answered (b), please continue the questionnaire.

35. How long does your pain usually last after a mission?

_____ minutes _____ hours _____ days

36. When is the discomfort the greatest?

_____ morning _____ afternoon _____ evening

_____ flying an aircraft _____ driving a car ____ standing ___ sitting

37. Which of the following describes the effect on your work?

_____ none _____ distracting _____ limiting _____ incapacitating

38. Have you been off work because of your backache? _____ yes _____ no

39. If yes, how many days have you been off in the last year? _____

40. What are you doing when your backaches usually occur? _____ playing sports

_____ driving a car _____ flying an aircraft _____ lifting a load

41. Are you more likely to get a backache if you are _____ tired, _____ tense

_____ bored, _____ worried, ____ angry or _____ other.