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# Flying Personnel Research Committee

**The Incidence of Backache  
among Aircrew and Groundcrew  
in the Royal Air Force**

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ABSTRACT

To determine the incidence of backache in Royal Air Force aircrew a questionnaire-type survey involving two thousand aircrew and groundcrew was carried out in 1969-70. Aircrew showed an incidence significantly higher than that in groundcrew. Among the aircrew group the incidence of backache in pilots was significantly higher than that in navigators and other aircrew combined. Pilots using ejector seats showed a higher incidence than those using static seats; among the latter group helicopter pilots suffer more discomfort than their colleagues using other types of static seats. More than half of the pilots who experience frequent in-flight backache or pain never suffer from backache on the ground.

backache Royal Air Force personnel; incidence comparison aircrew and groundcrew; trade/age comparison; trade/aircrew seat-type comparison; incidence comparison in ambulatory/sedentary groundcrew.

## INTRODUCTION

Medical Officers looking after aircrew have long suspected that the incidence of backache among military aviators is abnormally high. Medical statistics are of little or no help in gauging the magnitude of the problem since, as a general rule, only those aircrew who suffer from backache on the ground as well as in the air seek medical advice; the others, whose troubles are limited to the in-flight periods, realize that there is nothing structurally wrong with their spines, little or nothing for the doctor to find or treat and nothing that a reasonable rest-period between flights will not cure.

During the years 1966-1968 one of the authors carried out a pilot survey of the incidence of backache among a hundred aircrew attending various courses at the Royal Air Force Institute of Aviation Medicine. This study was of very limited value since it involved only sixty pilots, forty navigators and other aircrew and made no attempt to compare these with a non-aircrew group. In addition, it could be said to be biased since it involved only aircrew who might, for one reason or another, have been specially selected for course attendance. It did appear, however, to substantiate the belief that the incidence of backache among aircrew was higher than would be expected since nearly 50 per cent of the sample experienced backache or back pain at least once a month and in over half of these, the discomfort was experienced only during flight.

## METHODS

The findings of the initial study suggested that this was an aspect of aircrew health which deserved closer attention since persistent discomfort causes preoccupation and distraction and might interfere with the performance of complex flying tasks.

There are a number of civilian surveys and estimates which give some indication of the extent of the problem among selected occupa-

tional groups, but as these include persons up to the age of sixty-five or over and do not exclude those with backache or back pain due to a variety of non-spinal pathological conditions, the information to be gleaned from them was considered to be of little use for comparison purposes. For experimental control purposes it is well nigh impossible to match the unique aircrew occupation; nevertheless, it was considered that useful information could be obtained by comparing aircrew with groundcrew since the latter are of the same sex and race, of comparable ages, experience similar environmental conditions at home and abroad and, like aircrew, are a selected group in that they satisfy minimum physical and mental fitness standards. The use of groundcrew as a control group had the additional advantage that they were readily available on the same Royal Air Force Stations as the aircrew.

An anonymous questionnaire using multiple choice rather than open-ended questions was considered to be the best means of eliciting the information required and ample space was provided for additional comments. It was hoped that the information collected would show:

- a. If there is a difference in the incidence of backache in aircrew and groundcrew.
- b. If there is a difference in incidence in pilots, navigators and other aircrew.
- c. If the incidence is different in pilots using ejector, flight-deck and helicopter seats.

A copy of the questionnaire is shown in Annex A. With hindsight it is apparent that, in the case of aircrew, more information regarding the comfort or lack of comfort in various seat-cockpit combinations could have been gained if all aircrew, rather than just those who admitted to backache, had been requested to complete Part III of the questionnaire. Additionally, there is the possibility that a

small proportion of respondents, both aircrew and groundcrew, may have seized the opportunity to avoid filling up the entire questionnaire by providing a negative reply to the questions in Part 1. If this happened it is the belief of the authors that it happened so infrequently that it would make little or no difference to the results quoted in the following pages.

Twelve Royal Air Force Stations in the United Kingdom, Germany and the Far East and one Army Air Corps (Helicopter) Wing took part in the survey. In the case of aircrew, advantage was taken of the customary early morning briefings which start the day's flying on operational stations. These briefings are attended by all available aircrew and with the co-operation of the Wing Commander, Flying, there was rarely any difficulty in getting completed questionnaires from up to about 85 per cent of the aircrew strength of a station during the fifteen minute periods which were very willingly allotted for the survey at these briefings. The only aircrew who were not polled at morning briefings were some of those engaged in flying transport and communication aircraft; these were issued with questionnaires for completion and return to the Senior Medical Officer of the unit. The army contribution was under the supervision of the Army Air Corps Aviation Medicine Specialist. Groundcrew filled in the questionnaires in groups of from five to twenty-five within their own sections as they could be spared from their work. This took up considerably more time than the aircrew portion as more care had to be taken to ensure that senior NCO's in charge of the airmen understood the need for random sampling. Questionnaire filling sessions for both aircrew and groundcrew were preceded by a brief outline of the aims of the survey and care was taken not to influence the subjects, one way or the other. The most useful contributions, providing clear, precise answers with ample comment, came from the personnel who had been allotted ample time to fill up the questionnaire as members of a group, whereas the questionnaires returned by the four or five per cent of aircrew and groundcrew who had been instructed to fill them up in their own time were often incomplete or even contradictory.

Altogether a total of 988 aircrew and 1,124 groundcrew took part in the survey; of the aircrew 644 were pilots (P), 262 were navigators (NAVS), and 82 were aircrew other than pilots and navigators (e.g., flight engineers) and these are referred to in the tables under the heading AIR-0. In some of the tables the groundcrew, too, are divided into two groups for the purpose of comparing those whose jobs could be considered to be predominantly ambulatory with those predominantly sedentary. Aircraft fitters, workshop and maintenance personnel appear under the heading GC (AMB) and clerks, secretarial staff, drivers and flight controllers are labelled GC (SED).

The information resulting from the questionnaires was coded and punched on cards for analysis by computer; the spontaneous comments, however, had to be checked individually.

The results of the survey are presented in roughly the same order as the questions appeared in the questionnaire. For easier reading most are presented as answers to specific questions but it should be noted that these direct questions are often substitutions for several cumulative-type questions in the questionnaire.

Where useful to do so and where trade samples are sufficiently sizable to make comparisons valid, trade incidences are compared by age groups. In the tables a single figure in a box is always a percentage; if two figures appear, the top figure is the percentage and that at the bottom indicates the number in the sample unless otherwise stated. Since respondents were encouraged to tick as many boxes as they thought appropriate, percentages when added may exceed 100. Where respondents failed to tick at all when, clearly, they should have done so, the percentage failing to respond is shown under the heading 'Blank'. Fig. 1 shows the daily, weekly and monthly incidence of backache/pain in specific trade/age groups in the Royal Air Force.

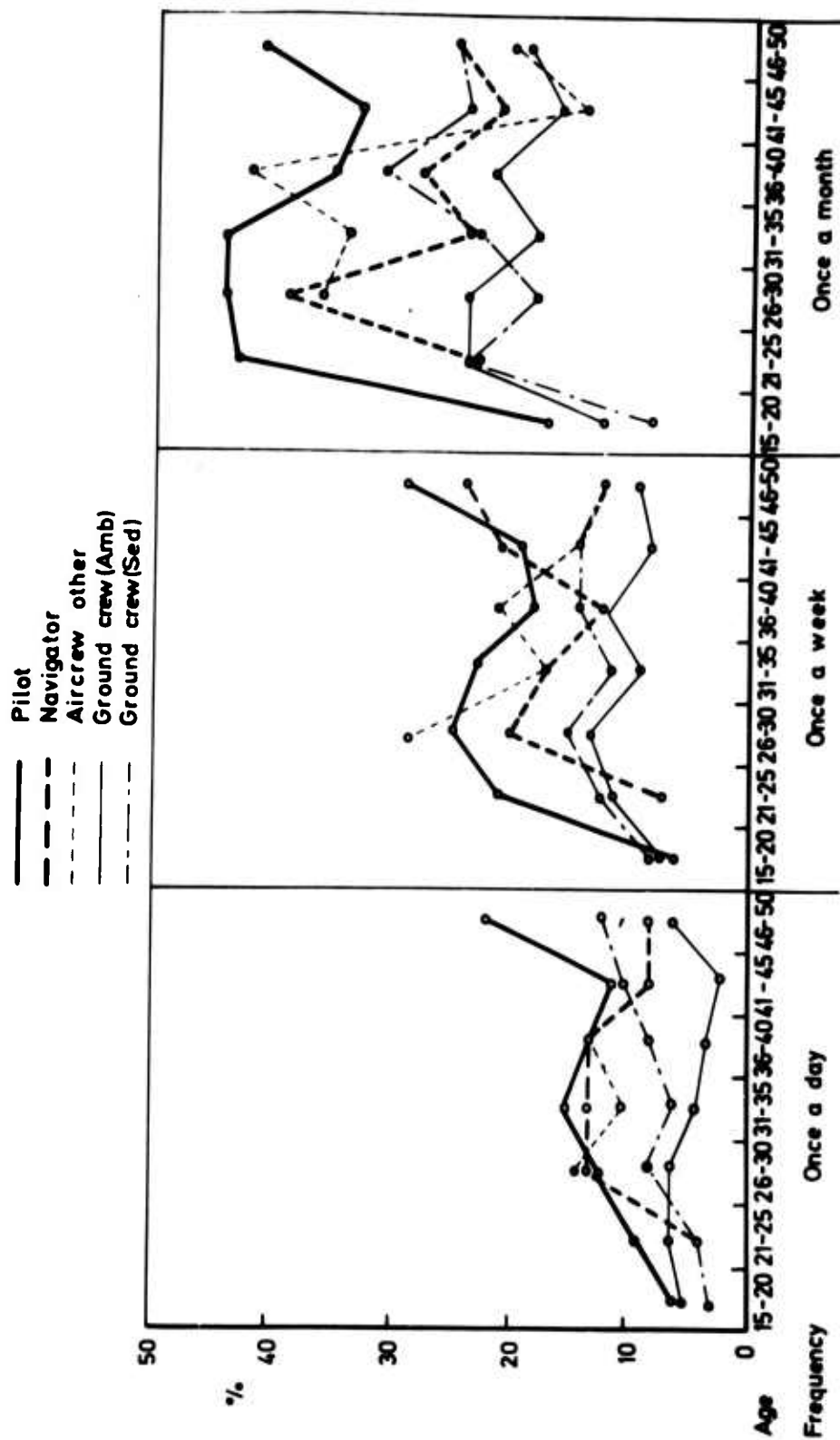


Fig. 1. The incidence of backache/pain in RAF personnel expressed as a percentage of the total within specific trade/age groups.

Aircrew and Groundcrew

TABLE 1

Q. Apart from the normal tired back following gardening, etc, have you ever had backache or back pain?

(The figures for each trade/age group show the incidence as a percentage of the total within that trade/age group).

Trade	Yes %	No %	Age 16-20	Age 21-25	Age 26-30	Age 31-35	Age 36-40	Age 41-45	Age 46-50
Pilot	66	34	28	59	65	68	68	57	66
Navigator	49	57	*	34	56	43	61	46	*
Air - Other	55	45	*	33	57	59	63	39	60
Groundcrew (AMB)	38	62	25	40	39	39	44	44	28
Groundcrew (SED)	37	64	21	31	40	43	44	48	56

\* = insufficient sample, i.e., 4 or less

TABLE 2

Q. How frequent are your attacks?

Age Group →	16-20			21-25			26-30			31-35			36-40			41-45			46-50					
	P	OC	OC AMB	P	OC	OC AMB	P	OC	OC AMB	P	OC	OC AMB	P	OC	OC AMB	P	OC	OC AMB	P	OC	OC AMB			
About once a day	6	4	5	9	5	6	12	7	6	8	5	4	6	13	6	3	8	6	2	10	22	9	6	12
About once a week	6	7	7	21	12	11	25	14	13	15	23	10	9	11	13	12	14	19	10	7	29	11	9	12
About once a month	17	10	12	43	24	24	44	21	24	18	44	20	18	23	29	27	31	19	16	24	41	21	19	24
Two or three times a year	17	10	12	47	25	26	46	21	25	18	47	25	19	31	29	28	30	21	18	24	41	25	19	31
About once a year	22	22	22	56	33	36	58	34	35	33	62	36	34	40	39	40	39	35	36	34	46	36	28	44
Once in 5 years or less	27	23	23	59	35	40	63	39	39	40	68	41	39	43	44	44	44	46	44	48	66	42	28	56
NEVER	72	77	75	41	63	60	37	61	61	60	32	59	61	57	54	54	56	43	54	56	34	58	72	44
	13	108	78	63	204	142	51	112	106	36	37	87	67	20	75	55	20	31	40	25	14	30	23	7

A COMPARISON OF THE INCIDENCE OF BACKACHE/PAIN AMONG PILOTS (P) AND GROUND CREW (GC)

(The figures for each trade/age/frequency group show the incidence as a percentage of the total within that trade/age group. The lower number in the boxes is the number in the sample).

TABLE 3

A COMPARISON OF THE INCIDENCE OF BACKACHE/PAIN AMONG PILOTS (P), NAVIGATORS (NAV), OTHER AIRCREW (AIR O) AND GROUNDCREW (GC)

(The figures for each trade/age/frequency group show the incidence as a percentage of the total within that trade/age group).

Age Group →	26-30					31-35					36-40					
	Pilot	Nav	Air-Other	GC	Pilot	Nav	Air-Other	GC	Pilot	Nav	Air-Other	GC	Pilot	Nav	Air-Other	GC
Frequency ↑																
About once a day	12 N	13 7	14 2	7 15	15 17	13 6	10 3	5 6	13 12	8 5	12 3	6 6	13 12	8 5	12 3	6 6
About once a week	25 N	20 4	29 2	14 17	23 10	17 2	17 2	10 8	18 5	12 3	21 2	13 11	18 5	12 3	21 2	13 11
About once a month	44 N	39 10	43 2	21 20	44 25	24 3	34 5	20 14	35 16	28 10	42 5	28 20	35 16	28 10	42 5	28 20
Two or three times a year	46 N	46 4	43 0	21 2	47 3	28 2	45 3	25 4	39 4	30 1	46 1	29 1	39 4	30 1	46 1	29 1
About once a year	58 N	50 2	57 2	34 26	62 17	41 6	59 4	36 19	51 11	53 15	54 2	39 15	51 11	53 15	54 2	39 15
Once in five years or less	63 N	56 3	57 0	36 11	68 8	43 1	59 0	40 7	68 16	61 5	62 2	44 5	68 16	61 5	62 2	44 5
NEVER	37 N	44 24	43 6	61 112	32 37	57 26	41 12	59 44	32 30	39 25	37 9	56 75	32 30	39 25	37 9	56 75

TABLE 4

Q. What age were you when you experienced backache/pain for the first time in your life?

(The figures for each trade/age group are percentages of the total within that trade/age group who have ever experienced backache/pain).

Trade	<20	21-25	26-30	31-35	36-40	41-45	46-50	Blank
Pilot	3	19	20	9	5	3	1	6
Nav	3	14	10	7	4	3	1	7
Air-0	5	13	17	15	8	4	1	4
GC (AMB)	7	9	8	5	3	2	1	8
GC (SED)	7	8	6	4	2	1	0	11

TABLE 5

Q. Describe your first attack.

(The figures for each trade/onset or each trade/symptom group are percentages of the total within that trade group who have ever experienced backache/pain).

Trade	Onset %		Symptoms %				Can't Remember	Blank
	Sudden	Gradual	Pain	Ache	Dull	Sharp		
Pilot	35	61	33	59	53	28	4	3
Nav	38	52	27	64	53	28	5	4
Air-0	49	50	30	63	51	26	3	3
GC (AMB)	49	43	49	36	37	37	2	3
GC (SED)	51	42	41	48	48	30	8	2

TABLE 6

Q. Describe the location of the original pain or ache.

(The figures for each trade/site group are percentages of the total within that trade group who have ever experienced backache/pain).

Trade	Upper Back	Middle Back	Lower Back	Mid-Line	To One Side	Blank
Pilot	8	27	67	77	14	4
Nav	3	31	66	84	7	1
Air-O	3	20	74	82	8	3
GC (AMB)	7	23	67	78	10	3
GC (SED)	14	32	52	85	10	2

TABLE 7

Q. Did the ache/pain persist at the original site or did it radiate?

(The figures for each trade/site and each trade/radiation group are the percentages of the total within that trade group who have ever experienced backache/pain).

Trade	Persisted at Original Site	Radiated to:			Blank
		Buttock	Buttock and Thigh	Buttock Thigh and Calf	
Pilot	83	11	7	3	3
Nav	79	12	6	3	5
Air-O	73	20	19	9	6
GC (AMB)	78	13	5	3	3
GC (SED)	78	15	10	4	2

TABLE 8

Q. What were you doing at the time of your first attack?

(The figures for each trade/activity group are the percentages of the total within that group who have each experienced backache/pain).

Trade	Playing a Game	Stooping	Pivoting	Gardening	Lifting a Load:			Flying	Other	Can't Remember	Blank
					Off the Floor	In Front of the Body	Above the Head				
Pilot	7	11	4	4	5	6	1	43	24	11	3
Nav	8	17	2	8	8	8	1	33	15	19	3
Air-O	6	9	4	0	13	7	3	35	26	16	1
GC (AMB)	10	21	6	3	15	8	3	3	26	19	3
GC (SED)	14	20	7	1	10	7	1	2	39	15	1

N.B. The most commonly listed other activities were: slipping while walking, diving, falling off something, sexual intercourse, sneezing, sitting at a desk.

TABLE 9

Q. Describe your present attacks.

(The figures for each trade/symptom description group are percentages of the total within that trade group who have experienced backache/pain at least once during the 12 month period preceding the survey).

Trade	Pain	Ache	Combination of Both	Dull	Sharp	Burning	Mild	Moderate	Severe Occasionally	Severe Often	Blank
Pilot	8	61	21	63	12	4	21	34	22	2	8
Nav	3	69	17	60	15	1	21	35	15	1	9
Air O	6	61	23	61	11	3	7	36	24	1	10
GC (AMB)	14	40	30	38	13	3	16	24	25	3	10
GC (SED)	9	60	23	62	14	2	21	16	40	1	5

TABLE 10

Q. What is the location of your present attacks?

(The figures for each trade/site group are the percentages of the total within that trade group who have experienced backache/pain at least once during the 12 month period preceding the survey).

Trade	Upper Back	Mid Back	Lower Back	Mid-Line	To One Side	Back and Buttock	Back, Buttock and Thigh	Back, Buttock Thigh and calf	Varies	Blank
Pilot	9	25	63	74	14	14	5	1	3	6
Nav	4	27	64	72	7	11	2	0	3	5
Air O	4	21	61	74	7	11	9	4	4	4
GC (AMB)	6	19	59	74	11	8	4	1	4	5
GC (SED)	12	38	46	76	10	12	5	1	2	6

TABLE 11

Q. When is your discomfort greatest?

(The figures for each trade/activity group, trade/time of day group, or trade/climate group are percentages of the total within that trade/group who have experienced backache/pain at least once during the 12 months period preceding the survey).

Trade	In Bed	After Getting Out of Bed	Working:				Sitting	Standing	Walking	Lying:		
			Scooping	Scooped	Above the Head	With Trunk Twisted				On the Side	On the Back	On the Stomach
Pilot	7	14	17	6	3	7	30	16	5	2	4	5
Nav	9	19	22	5	0	4	31	19	5	3	3	4
Air-O	4	23	17	4	4	14	37	13	4	3	0	0
GC (AMB)	10	20	32	9	2	12	21	18	8	3	0	3
GC (SKD)	9	14	21	7	1	11	38	14	4	2	5	10

	Morning	Afternoon	Evening	Cold Climates	Hot Climates	Blank
Pilot	9	4	14	12	2	8
Nav	9	4	15	10	3	9
Air-O	6	5	10	7	1	10
GC (AMB)	15	7	21	13	2	9
GC (SKD)	12	14	21	6	1	6

TABLE 12

Q. Describe (a) how you feel during an attack and (b) what is the effect on your work.

(The figures for each trade/feeling group and each trade/effect on work group are percentages of the total within that trade group who have experienced backache/pain at least once during the 12 month period preceding the survey).

Trade	Fatigued	Irritated	Frustrated	Upset	Effect on Work				Blank
					None	Distracting	Limiting	Incapacitating at times	
Pilot	38	42	12	2	26	50	9	6	5
Nav	49	34	14	2	37	46	6	6	3
Air O	34	39	14	1	39	39	11	11	6
GC (AMB)	30	45	9	8	29	34	14	9	4
GC (SED)	35	43	11	1	28	51	11	9	4

TABLE 13

Q. How much time have you lost from your work because of backache/pain in the last five years?

(The figures for each trade/man-hour loss group are percentages of the total within that trade group who have experienced backache/pain at least once during the five year period preceding the survey).

Trade	None	Less than a Week	About a Week	1 - 4 Weeks	Between 1 and 3 Months	Less than 6 months	6 - 12 months	Blank
Pilot	73	20	12	6	1	1	0	6
Nav	83	14	8	4	1	1	0	3
Air O	67	29	13	8	2	2	1	4
GC (AMB)	70	18	17	9	3	1	0	12
GC (SED)	74	17	13	3	1	1	0	9

TABLE 14

Q. Are your attacks more likely to occur if you are:

(The figures for each trade/mood group are percentages of the total within that trade group who have experienced backache/pain at least once during the 12 months preceding the survey).

Trade	Tired	Bored	Tense	Worried	Angry	Frustrated	Other	Blank
Pilot	32	7	16	2	0	1	12	6
Nav	35	5	8	3	0	3	11	3
Air-O	41	3	10	3	0	1	16	7
GC (AMB)	37	4	15	6	1	2	11	9
GC (SED)	42	8	11	4	1	2	10	14

N. B. Most frequent comments under OTHER heading - Cold cockpits, long flights, instrument flying, hard day's flying (Aircrew). Cold, cold winds, long parades, extended work periods (Groundcrew).

TABLE 15

Q. Once an attack has developed how long does it usually last?

(The figures for each trade/duration group are percentages of the total within that trade group who have experienced backache/pain at least once during the 12 months preceding the survey).

Trade	<1hr	1-2 hrs	2-4 hrs	4-12 hrs	12-24 hrs	1-2 days	2-7 days	>7 days	Varies	Blank
Pilot	13	12	14	12	2	5	18	4	2	18
Nav	12	12	18	15	2	10	25	2	1	15
Air-O	3	7	16	19	1	7	29	0	4	19
GC (AMB)	6	3	9	13	2	9	28	5	0	21
GC (SED)	3	4	8	11	2	5	16	1	1	14

TABLE 16

- Q. (a) Have you sought treatment for your back?  
 (b) If you have, did you benefit?

(The figures for each trade/therapist/benefit group are percentages of the total within that trade group who have experienced backache/pain at least once in the 12 months preceding the survey).

Trade	Yes	No	Service M.O.	Specialist	Another Doctor	Osteopath	Other	Blank (a)	Blank (b)
Pilot	40	53	34 18	11 8	3 1	5 4	3 2	6	11
Nav	37	59	33 22	8 3	0 0	4 1	0 0	4	10
Air-O	44	36	39 21	13 1	3 3	6 6	1 1	20	15
OC (AMB)	53	36	42 31	13 11	8 4	1 0	4 1	11	13
OC (SED)	59	33	49 26	16 11	3 2	5 2	1 1	7	8

N. B. The answer to (b) is the bottom figure in the boxes.

TABLE 17

- Q. From which of the following treatments did you benefit most?

(The figures for each trade/treatment group are percentages of the total within that trade group who have experienced backache/pain at least once during the 12 months preceding the survey).

	Rest	Heat	Medicine	Hard Bed	Massage	Exercises	Manipulation	Surgery	Other	Blank
Pilot	25	17	3	11	9	10	8	0	7	36
Nav	32	17	5	9	7	8	2	0	9	38
Air-O	23	16	4	13	11	11	7	1	0	41
OC (AMB)	26	31	7	13	14	15	2	0	3	18
OC (SED)	22	27	5	19	10	15	1	2	3	30

TABLE 18

Q. In which of the following seats are you uncomfortable?

(The figures for each trade/seat group are percentages of the total within that trade group who have experienced backache/pain at least once in the 12 months preceding the survey).

	Kitchen	Levage	Car	Work Seats	Theatre	Railway	Ejector	Flight-Deck	Helicopter	Air Passenger	Blank
Pilot	18	21	32	37	21	17	46	21	12	10	6
Nav	22	18	34	39	20	14	39	33	3	11	3
Air-O	26	26	21	39	24	21	8	39	6	15	6
OC (AMB)	21	32	18	25	23	16	1	5	3	10	12
OC (SUD)	15	30	23	38	17	15	0	0	0	2	5

TABLE 19

(The figures for each trade/experience group and trade/seat group are percentages of the total within that trade who have experienced backache/pain at least once during the 12 months preceding the survey).

	Total Flying Hours			Usual Type of Aircrew Seat			
	<1000	1000-3000	>3000	Ejector	Flight-Deck	Helicopter	Blank
Pilot	21	37	39	51	37	9	2
Nav	16	44	38	36	57	2	5
Air-O	3	42	46	4	85	3	6

TABLE 20

- Q. What is (a) your average number of flights per flying day?  
 (b) the average duration of each flight?

(The figures for each trade/flight number and trade/flight duration are percentages of the total within that trade who have experienced backache/pain at least once during the 12 months preceding the survey).

	Average Number of Flights Per Day						Average Duration of Each Flight						
	1	2	3	4	5	Blank	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs or more	Blank
Pilot	48	36	11	1	0	4	48	9	8	9	9	16	2
Nav	92	4	2	0	0	3	3	16	23	7	21	25	4
Air-O	81	13	0	0	0	6	3	3	3	5	31	48	6

TABLE 21

- Q. (a) In which of the following aircraft have you considerable experience  
 (b) In which are you most likely to develop back discomfort?

(The figures for each trade/aircraft group are percentages of the total within that trade who have experienced backache/pain at least once during the 12 months preceding the survey. The top figure is the answer to (a) the bottom figure is the answer to (b)).

	Jet Provost	Can-Berra	Light-Wing	Chip-mank	Dunter	Vul-Can	Vic-Tor	Shackle-Ton	Trans-Port	Heli-Copter	Blank
Pilot	13 11	14 16	3 1	9 6	3 2	2 2	6 3	3 2	27 10	9 8	10 19
Nav	0 0	36 27	1 0	0 0	0 0	2 3	18 11	2 1	37 21	1 1	13 18
Air-O	0 0	4 3	0 0	0 0	0 0	4 6	21 16	24 16	34 13	4 4	8 21

TABLE 22

Q. Is your backache/pain present on:

(The figures for each trade/flight group are percentages of the total within that trade who have experienced backache at least once in the 12 months preceding the survey).

	All Flights	Most Flights	Some Flights Only	Occasional Flights Only	Blank
Pilots	10	18	32	32	8
Navs	4	14	34	36	12
Air-0	9	13	21	42	15

TABLE 23

Q. Once seated in your aircraft how soon does your backache/pain begin?

(The figures for each trade/time to onset group are percentages of the total within that trade who have experienced backache/pain at least once in the 12 months preceding the survey).

	Within 1/2 hr	Within 1 hr	Within 2 hrs	Within 3 hrs	Within 4 hrs	After About 4 hrs	Blank
Pilots	22	21	16	15	4	4	18
Nav	13	11	14	29	7	3	13
Air-0	9	9	9	18	15	6	14

TABLE 24

Q. Once started, for how long does the ache or pain last?

(The figures for each trade/ache or pain duration group are percentages of the total within that trade who have experienced backache/pain at least once in the 12 months preceding the survey).

	< 1 hr	1 < 2 hrs	2 < 4 hrs	> 4 hrs	Throughout The Flight	For 1-2 hrs After Flight	For 2-4 hrs After Flight	Till Bed Time	Blank
Pilot	8	31	14	8	66	28	16	16	11
Nav	3	15	43	15	73	24	19	17	13
Air-O	6	9	12	26	52	22	17	17	21

TABLE 25

Q. Do you have difficulty straightening your back after flight?

(The figures for each trade/duration group are percentages of the total in that group who have experienced backache/pain in the 12 months preceding the survey).

	YES	For $\frac{1}{4}$ hr	For $\frac{1}{2}$ hr	For 1 hr	For 2-4 hrs	Blank
Pilot	21	10	5	2	1	11
Nav	26	9	6	4	1	18
Air-O	18	7	4	2	1	14

TABLE 26

Q. During routine flights do you keep (a) your shoulder straps and (b) your lap-straps tight?

(The figures for each trade/strap state group are percentages of the total within that trade who have experienced backache/pain at least once during the 12 months preceding the survey).

	ALL THE TIME	MOST OF THE TIME	SHORT TIME ONLY	NEVER	BLANK
Pilot	36 63	29 25	28 8	5 1	2 3
Nav	10 22	22 19	58 51	7 5	3 3
Air-0	3 12	4 10	61 55	24 16	7 6

N. B. In the boxes the top figure is the answer to (a), the bottom figure to (b).

TABLE 27

Q. During leave periods when you are not flying do you experience backache/pain?

(The figures for each trade/frequency group are percentages of the total within that trade who have experienced backache/pain at least once in the 12 months preceding the survey).

	More Frequently	With the Same Frequency	Less Frequently	Rarely	Never	Blank
Pilots	3	20	10	21	31	15
Navs	3	21	9	27	27	12
Air-0	1	30	13	16	26	13

TABLE 28

Q. Has your in-flight backache/pain ever been sufficiently severe or frequent to:

	Pilots		Nave		Air-O	
	A	B	A	B	A	B
Make you wish you had a different occupation	1	1	8	3	11	9
Interfere with your relaxation after flight	29	20	29	13	37	30
Interfere with your sleep after flight	16	11	17	8	22	18
Interfere with your appetite after flight	2	1	3	1	3	2
Make you want to go to bed early	17	12	14	6	19	16
Make you feel irritable with your Air or Ground-crew	15	10	13	6	13	11
Make you wish you could abort a sortie	13	9	10	5	10	9
Impair your concentration during flight	22	15	22	10	19	16
Distract your attention during flight	31	25	25	11	22	18

N.B. Percentages in the 'A' columns refer to the aircrew population who have experienced backache/pain at least once in the 12 months preceding the survey.

Percentages in the 'B' columns reflect the effects of backache on the entire aircrew population, e.g., 25 per cent of all pilots have experienced in-flight distraction as a result of backache or back pain.

TABLE 29

Q. How would you, who have experience of in-flight backache or pain, rate ejector seats (E) flight-deck seats (FD) and helicopter seats (H) from the in-flight comfort point of view?

		Very Comfortable	Reasonably Comfortable	Very Uncomfortable	Need to be Improved	Need a Great Deal of Improvement	Blank
Pilots	E	1	16	35	42	30	
	FD	3	32	12	31	16	12
	H	2	19	19	35	29	
Navs	E	2	15	34	38	18	
	FD	3	18	26	28	16	14
	H	2	16	27	31	20	
Air-0	E	-	-	-	-	-	
	FD	2	22	16	28	26	18
	H	1	20	19	27	27	

TABLE 30

A comparison of the incidence of backache/pain among pilots using ejector seats, flight-deck seats, and helicopter seats, (age 20-50).

(The figures for each pilot/aircrew seat group are percentages of the total number of pilots, aged between 20 and 50, who, in the 12 months preceding the survey, (a) flew exclusively in one or another of the crew seats listed and (b) experienced backache/pain at least once during that period).

Frequency	Ejector Seat Users	Flight - Deck Seat Users	Helicopter Seat Users	All Pilots - Various Types of Aircrew Seats	All Groundcrew
About Once A Day	15	9	12	12	6
About Once A Week	26	18	23	22	12
About Once A Month	46	33	44	40	22
Two Or Three Times A Year	48	37	44	43	23
About Once A Year	51	39	45	45	33

RESULTS

1. The incidence of backache in aircrew is significantly greater than that in groundcrew. (P = 0.001).

TABLE 31

	<u>Backache</u>	<u>No Backache</u>	
Aircrew	576	412	$\chi^2 = 92.46$ D.F. = 1
Groundcrew	420	704	P = 0.001

2. The incidence of backache in pilots is significantly greater than that in navigators and other aircrew combined. (P = 0.001).

TABLE 32

	<u>Backache</u>	<u>No Backache</u>	
Pilots	405	239	$\chi^2 = 16.02$ D.F. = 1
Navs and Air-O	171	173	P = 0.001

3. Pilots using ejector seats show a higher incidence of backache than those using static seats. (P = 0.05).

TABLE 33

	<u>Backache</u>	<u>No Backache</u>	
Ejector Seat	114	109	$\chi^2 = 4.98$ D.F. = 1
Static Seat	81	120	P = 0.05

4. The flight environment (i.e., seat, seat harness, flying clothing assembly and surrounding cockpit) is the sole cause of backache in significantly more than 50 per cent of affected aircrew. (P = 0.001).

TABLE 34

	<u>Sole Cause</u>	<u>Partial Cause</u>	
Pilots	211	133	$\chi^2 = 21.81$ D.F. = 1
Navs	71	43	P = 0.001
Air-0	19	20	
Total	300	196	

(Analysis performed on totals)

5. Backache occurs most frequently in the lower back but a greater incidence of lower backache occurrences is associated with both aircrew and ambulant groundcrew as opposed to sedentary groundcrew.

TABLE 35

	<u>Upper Back</u>	<u>Mid-Back</u>	<u>Lower Back</u>	
Aircrew	37	158	390	$\chi^2 = 21.791$
Ambulant Groundcrew	16	53	154	D.F. = 4
Sedentary Groundcrew	32	73	119	P = 0.001

DISCUSSION

All the respondents were encouraged to comment freely and a gratifying 62 per cent of those with troublesome backache did so, and at some length. These comments provided useful additional information which could be cross-checked against the responses of other aircrew or groundcrew engaged in flying the same aircraft or the same ground task.

The most important factors which appear to influence both the frequency and the severity of back discomfort in aircrew are:-

- a. The seated environment, i.e., the seat, the flying clothing assembly and the immediate cockpit surroundings.

- b. The duration of flight.
- c. The duration of rest periods between flights.
- d. The proportion of in-cockpit time during which tight shoulder harness is essential.
- e. The in-flight conditions.
- f. The presence or absence of arm-rests on the seat.

There was no shortage of comments about the short-comings of aircrew seats and it would have been surprising if this were not so since aircrew seats are located in cramped surroundings, are sat upon, usually without interruption, for much longer periods than domestic or car seats and many have to double as escape vehicles in emergency situations. Aircrew are well aware of these limitations and in this survey their criticisms were, generally, directed against seat design features which they considered to be unnecessarily bad.

Seats in which the body contact areas are provided by the flexible surfaces of parachute or survival gear packs were considered to be very unsatisfactory by a great many aircrew. These packs have to be inspected and repacked frequently with the result that the comfort of the seat occupant depends on the skill and diligence of the packer. Parachute packs which push the shoulders away from the back of the seat and parachute seat-pan packs which, sometimes, are dome-shaped rather than flat were frequently mentioned; many approved of the trend towards housing these items of equipment in rigid, properly contoured containers.

Lack of adequate support for the small of the back was cited as the main single cause of back discomfort and fatigue by very many respondents and many of these used 'gap-fillers' ranging from the left forearm through stuffed socks to paper-back novels to get temporary relief.

Another frequent comment was that most aircraft seats, and especially helicopter seats, were too upright; a minimum of another 5° of rake would be welcomed. Heavy crash helmets were blamed occasionally for pain in the upper spine in pilots flying high performance aircraft in which constant rotation of the head and neck is a necessity during periods when the body is subjected to high acceleration loads. Comments about the relationship between spinal loading and spinal pain were frequent; the theme that aircrew spines are already overloaded and that new flying clothing assemblies are, more often than not, heavier than their predecessors recurred constantly. Having to sit in a cold cockpit within minutes of the sweaty struggle involved in donning modern flying clothing, particularly if an immersion suit is part of the assembly, appears to result in the rapid development of backache in a small proportion of aircrew.

For many of the backache-prone it is the duration of flight which is the important factor with more and more succumbing as the in-flight time mounts; in others flight duration is less important than the proportion of in-flight time during which tight shoulder harness is essential and very often these are the same respondents who object to heavy helmets and heavy clothing assemblies and these are also the aircrew who are much more comfortable when posted from instructional flying in aircraft such as the Jet Provost to operational flying in aircraft such as the Victor or Vulcan. In the latter aircraft in-flight time may be five or six times that of the average Jet Provost flight but the necessity for tight shoulder harness ceases within minutes of leaving the ground.

Another aspect of shoulder restraint which many aircrew considered to be of importance in the initiation of spinal deformation is the permanent anchorage of the shoulder straps at a fixed point on the back of the seat. Tall aircrew, particularly, would welcome the facility whereby the seat occupant could adjust the vertical location of the anchorage point so that the straps could be made to originate from a point immediately behind rather than from behind and below the shoulder tips.

About ten per cent of the pilots with frequent troublesome backache stated that discomfort became worse, or more noticeable, just before landing, in bad weather conditions or in any situation of high demand such as prolonged instrument flight, in-flight refuelling etc.

As the majority of the aircrew who took part in the survey were currently flying in aircraft fitted with ejector seats it was not surprising that most of the criticisms of aircrew seats referred to these; similarly, when certain seat-cockpit combinations came in for frequent adverse mention it was necessary to try to relate the total mentions to the total number of aircrew taking part in the survey who had experience of these particular seat-cockpit combinations. Bearing these points in mind there are, nevertheless, some seat-cockpit combinations which are undoubtedly more or less comfortable than others; the Canberra T4 with the Mk 3CT ejector seat is, unquestionably, the most disliked seat-cockpit combination in current use. Apparently severe space limitations, encountered in the retrofixation of an ejector seat in this cockpit, necessitated an abnormally upright if not forward tilt to the seat with the result that there is a tendency for the occupant's buttocks to slide forward on the seat squab while the upper trunk and head are encouraged to flex forward and away from the seat back.

The Jet Provost seat is not very popular either. The seat pan is considered to be too short to give adequate thigh support and, again, the seat back is thought to be too upright. Instructors using this aircraft are engaged in very intensive flying in which tight shoulder harness must be maintained throughout the flights, of which there may be three or four a day, and many consider that it is the prolonged use of tight harness which makes this seat uncomfortable.

In the Vulcan Mk 2 and Victor B Mk 1 and 2 (Mk 3KTS and Mk 3L seats respectively) the horseshoe-shaped back type parachutes are sources of rapid discomfort in some users as a result of enforced spinal flexion and yet several of the pilots who had previously

experienced troublesome backache while engaged in intensive flying in the Jet Provost commented that they would far prefer a five or six hour flight in a Victor or Vulcan than a single one hour flight in a Jet Provost with tight shoulder harness. It appears, therefore, that there are aircrew whose spines are particularly sensitive to prolonged compression forces while there are others who can tolerate compression but respond unfavourably to induced spinal flexion and it may be of some interest that the compression sensitive aircrew tended to be younger than the other group.

The Mk 4GT seat in the Gnat appears to be reasonably comfortable except when the Mk 7 immersion suit has to be worn by the occupant. This mark of immersion suit was castigated repeatedly; the two piece suit is sealed by wrapping the waist rubber sealing ends round each other until a semi-rigid tube of about 1 in. in diameter straddles the upper lumbar region. The tube, digging into the spine, can cause such acute discomfort that it was referred to as a flight-safety hazard by more than one respondent. This mark of immersion suit is now being phased out of service, not it appears, before time.

In the Lightning the type 4BS seats are liked by the majority of users and even the few who had experience of long flights in this aircraft had few adverse criticisms.

It might be expected that uncomplicated static aircrew seats could be designed to be reasonably comfortable for their users. This is not the case although, in many cases, the fault appears to be in the immediate seat environment rather than in the seat itself. For instance, in the static seats used by navigators and flight engineers etc., although there were criticisms of seat back rakes, seat squab lengths etc., the main complaints resulted either from restrictions of trunk or leg movements in cramped working spaces or the necessity, in some cases, to wear back-type parachute harnesses during the entire flight or the lack of adjustment facilities for seat or work-bench heights. For general comfort pilots flying transport

aircraft extol the VC10; the Britannia and the Hercules are not nearly as popular.

The backache which helicopter pilots suffer from appears to be quite different, both in causation and location, from that of their fixed-wing colleagues. To control a helicopter the right arm must be outstretched to the cyclic control while the left arm hangs more or less vertically with the hand on the collective lever. When these arm attitudes are maintained for more than a few minutes the tendency is for the upper trunk to rotate to the left while the left shoulder drops and the spine bends towards the left. This form of scoliosis stresses sensitive, normally non-load bearing joint membranes, and discomfort or pain may result on the left hand side of the spinal column at about the level of the junction of the lower thoracic and upper lumbar vertebrae. In addition, several of the helicopter pilot respondents described a second area of discomfort located to the right of the spine at the level of the base of the shoulder blade; this, very likely, is due to prolonged stretching of the right latissimus dorsi muscle when the right arm is maintained in the outstretched position.

Loss of lumbar lordosis can occur in helicopter seats and can give rise to low back pain but, apparently, it is extension rather than flexion of the spine which causes the most severe form of lower back discomfort in these pilots. This form of spinal deformation is most likely to occur either when the aircraft is flying forwards at high speed or when an underslung load is being carried. Both of these flying conditions induce a nose-down attitude in the aircraft which gives the pilot the feeling that he is falling out of his seat; when he attempts to combat this tilted position by tightening his shoulder harness he may well make matters worse by increasing the degree of spinal extension. A large number of helicopter pilots felt that a further five or even ten degrees of rearward tilt should be built into the back of helicopter crewseats. The seat in the Wessex Mk 2 was frequently mentioned in this context but the most disliked helicopter

seat-cockpit combination is that of the Whirlwind Mk 10, not so much because the seat itself is uncomfortable but because, for a relatively large number of pilots, it appears to be necessary to adopt a crouched position of the upper trunk and neck to secure adequate forward vision in this cockpit. In the Scout, on the other hand, a high degree of compatibility between the seat and seat environment seems to have been achieved.

Eighteen of the aircrew respondents had ejection experience. Seven fractured their spines, five had hurt their backs and six had escaped injury. In none of these case histories was there any evidence that the ejection experience had either initiated or worsened their back troubles.

The need for early indoctrination of young groundcrew recruits in safe methods of lifting and pushing was frequently mentioned by groundcrew; the orthopaedic ward is not the place to be informed of the value of bending the knees before attempting to lift a heavy engine part.

#### CONCLUSIONS

The following conclusions are drawn from the information contained in the tables and from that provided by the respondent's comments:

- a. Thirteen per cent of RAF pilots, aged between twenty and fifty, experience backache or back pain every time they fly. Twenty two per cent experience in-flight backache or back pain at least once during the course of a normal week's flying and up to forty per cent develop in-flight backache or pain at least once during the course of a normal month's flying.
- b. Among aircrew using ejector seats and static seats other than helicopter seats, dull, nagging aching which is gradual in

onset and confined to the midline of the lower back is the typical picture. When helicopter pilots experience backache the location is often at a higher level in the spine, i.e. at about the level of the junction of the thoracic and lumbar vertebrae, and there may be a second, separate area of discomfort located at the base of the right shoulder-blade.

c. In over fifty per cent of the aircrew who experience frequent in-flight backache or pain the sole cause of the discomfort lies inside the cockpit, i.e. either in the seat itself, the seat harness, the aircrew equipment assembly or in the seat environment or in a combination of these. In the other forty per cent or more the in-flight situation is but one of a number of situations conducive to backache.

d. The incidence of backache in aircrew is significantly greater than that in groundcrew. All aircrew trades are affected; in pilots the incidence is significantly higher than in navigators and other aircrew combined. In a questionnaire-type survey the respondent's estimate of the severity of his symptoms must be accepted unless his answers to other questions are so contradictory that it is obvious that the wrong box has been ticked either in error or because of indifference. There were very few errors of this type but in attempting to assess the degree of discomfort experienced by one respondent as opposed to another, it must be remembered that backache and back pain are purely subjective symptoms and that there is no way of comparing one respondent's discomfort quantitatively with another's. Accepting the respondent's assessments of their discomfort it appears that the Other Aircrew group and the Groundcrew (AMB) group are afflicted by back pain, rather than backache, more frequently than the Pilot group which, in turn, suffers more than either the Navigator or the Groundcrew (SED) group.

e. The difference in incidence between groundcrew and aircrew

is apparent from the age of twenty and the disparity is maintained at a more or less constant level right up to the age of forty or so, when, because of a decline in aircrew incidence and a rise in groundcrew, mainly sedentary groundcrew, incidence, the disparity becomes less marked.

f. In both aircrew and groundcrew an incidence peak occurs between the ages of twenty five and thirty. This is followed by a decline until at about the age of forty to forty-five a second peak develops.

g. It is unlikely that an airman or an aircrew officer who has been backache-free up to the age of 35 will develop backache thereafter unless he indulges in some activity for which he is untrained or out of training.

h. In neither aircrew nor groundcrew is there clear evidence that backache becomes more severe with advancing years but there is evidence of a gradual loss of the power of recovery and a need for longer and longer rest periods between activities likely to produce backache; if rest periods are inadequate the time to the onset of symptoms becomes progressively less until, in the case of some personnel in the 30-40 decade, there develops a state of chronic low back tension which disrupts relaxation and interferes with sleep.

i. Persistent aircrew backache is associated with premature fatigue, irritability, distraction from the flying task and interference with post-flight relaxation and sleep. In the case of aircrew serving in operational squadrons or instructing, day after day, it is conceivable that persistent in-flight back discomfort could lead to a chronically heightened stress level in which performance might be impaired if a condition of high demand should occur.

j. Eight aircrew respondents indicated that they knew of incidents in which the safety of an aircraft could have been in jeopardy as a result of the sudden appearance or the rapid worsening of a pilot's back pain. Only four of these incidents were described in detail; in two near incapacitating sciatica was experienced in the air, in one case just before touch down. In another, very severe low back pain was associated with lateral rotation of the upper back while pulling 'G' and in the fourth excruciating but, fortunately, short-lived low back pain accompanied an attack of sneezing.

k. Many of the seat inadequacies described by aircrew are already well known and steps are being taken to rectify some of them, e.g. in the more recent types of ejector seat survival packs are housed in rigid contoured containers. Methods of ensuring adequate support for the small of the back for aircrew using ejector and flight-deck type seats are now past the experimental stage and these supports, when available, will do much to improve seated comfort. Finally there is the question of whether the location of shoulder-strap anchorage points is as important a factor in the production of backache as many aircrew believe it to be; this is something that needs to be examined since it is possible that improperly anchored harness not only imposes unnecessary compression loading but interferes with restraint capability as well.

#### ACKNOWLEDGEMENTS

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BACKACHE SURVEY - MEDICAL CONFIDENTIAL

PART I

To be filled in by all subjects, aircrew and groundcrew. Please tick in one or more of the appropriate places in answer to questions.

N.B. Your name is not required anywhere on this form and information resulting from your answers will be used for statistical analysis only

Age ..... Height ..... ft ..... inches  
Aircrew Trade ..... Groundcrew Trade .....  
RAF Unit or Commercial Airline .....

Apart from the normal tired back following gardening, etc, have you ever had

backache or back pain? Yes No

Do you exercise regularly? Yes No

If yes how do you exercise?

Walk Cycle Golf Football Tennis  
Squash Group Physical Exercises Private Physical Exercises  
Other Please specify

.....  
If you are Groundcrew and have never had backache or back pain please hand this questionnaire to the collector NOW.

If you are Aircrew and have never had backache or back pain please answer the following questions before returning this questionnaire.

What aircraft are you flying at present?

.....  
What other aircraft have you flown regularly?

.....  
All those who suffer or have suffered from backache or pain should complete Part II or Part II and Part III as appropriate.

ANNEX A (continued)

PART II

How frequent are your attacks?

- Once in 10 years
- 5 years
- a year
- Once in a month
- a week
- nearly every day

What age were you when you experienced backache or pain for the first time in your life? .....

Have you ever had an accident involving your back? Yes No

If yes give details.

.....  
.....

FIRST ATTACK

The first attack was characterised by:

- Pain Dull Upper Back
- Ache Sharp Mid Back
- Burning Lower Back
- Can't Remember

Was the onset gradual or sudden

Did the pain or ache remain where it was? Yes No

or did it radiate to the buttock Thigh Calf

ANNEX A (continued)

Indicate which of the following describes how you feel when you have an attack.

Fatigued                      Irritated                      Frustrated                      Upset

Which of the following describes the effect on your work?

None                      Distracting                      Limiting                      Incapacitating at times

Have you been off work or off flying because of backache?

Yes                      No                      About how many days have you been off because of back trouble in the last 5 years?                      days.

Did you seek treatment                      Yes                      No                      from

Your RAF or Company Doctor                      A Service or Civilian Specialist

Another Doctor                      An Osteopath                      Other

From whom did you receive most benefit?

RAF or Company Doctor                      Service or Civilian Specialist

Another Doctor                      Osteopath                      Other

From which of the following forms of treatment did you benefit most?

Rest                      Heat                      Medicines                      Hard Bed                      Massage

Exercises                      Manipulation                      Other                      please specify

.....

In which of the following seats are you uncomfortable?

- |                   |                       |
|-------------------|-----------------------|
| Domestic, kitchen | Aircrew, ejector      |
| Domestic, lounge  | Aircrew, flight deck  |
| Car seats         | Aircrew, helicopter   |
| Work seats        | Airline, passenger    |
| Theatre seats     | Other, please specify |
| Railway seats     |                       |

ANNEX A (continued)

Are you more likely to get backache if you are

Tired            Tense            Bored            Worried            Angry

Frustrated            Other            , please specify .....

.....

Once an attack has developed how long does it usually last?

Days ..... Hours ..... Minutes .....

ANNEX A (continued)

What were you doing at the time?

Playing a game	Stooping	Pivotting	Lifting a load:
off the floor	in front of the body		above the head
Gardening	Flying	Can't remember	Other

Please specify .....

SUBSEQUENT ATTACKS:

When you are suffering from back discomfort now is it an

Ache	Pain	Combination of both
------	------	---------------------

Describe the discomfort.

Dull	Sharp	Burning	Pins and needles	Mild
Moderate	Severe occasionally	Severe often		

What is its location?

Upper Back	Mid-Back	Low Back	Mid-Line
To one side	Mid-Line and Buttock	Mid-Line and Thigh	
Mid-Line and Calf	Varies		

When is discomfort greatest?

In bed	After getting out of bed	Morning	
Afternoon	Evening	Stooping	Stooped

Working above the head      Working with the trunk twisted to one side

Sitting	Standing	Walking	Lying, on your side
---------	----------	---------	---------------------

On your back	On your stomach	Cold climates
--------------	-----------------	---------------

Hot climates	Other	Please specify .....
--------------	-------	----------------------

.....

ANNEX A (continued)

PART III - AIRCREW ONLY

Total flying hours .....

In which type of seat do you usually fly?

Ejector                      Flight Deck                      Helicopter

What is the average duration of your flights?

1/2 hr                      1 hr                      2 hrs                      3 hrs                      4 hrs  
5 hrs                      6 hrs                      7 hrs                      8 hrs                      longer

How many flights are there in the average day's flying?

1                      2                      3                      4                      5                      6                      7                      8

Which aircraft do you most commonly fly .....

In which aircraft are you most likely to develop backache or pain .....

Is your shoulder harness done up tightly?

All the time                      most of the time                      short time only  
never

Are your lap straps tight?

All the time                      most of the time                      short time only                      never

Have you ever ejected from an aircraft?

Yes                      No                      If yes did you - escape without injury  
hurt your back                      fracture your spine

If your flights are of short duration can you leave your seat between flights?

Yes                      No                      Do you?    Yes                      No                      If you don't is it because  
There is no time                      No inclination                      Too much trouble

ANNEX A (continued)

If your flights are of long duration (3-4 hrs or more) do you avail of rest periods to effect minor postural changes whilst remaining in your

seat alter the height, fore and aft position or rake of your seat

back vacate your seat periodically to stretch your legs and

back

Is your backache/pain present on all flights

Nearly all flights some flights only only very occasionally

How soon does discomfort begin?

Almost as soon as you are seated Within ..... hrs ..... mins of

being seated

Once started does the discomfort persist

Throughout the flight For about ..... mins ..... hrs

for about ..... mins ..... hrs after the flight

Till bedtime

Do you have difficulty in straightening your back after flight?

Yes No If yes for about how long ..... mins

..... hrs

During leave periods when you are not flying are your attacks

More frequent Just as frequent Less frequent Rare

Absent

If there is a difference to what do you attribute the difference .....

.....

ANNEX A (continued)

Has your backache/pain ever been sufficiently severe or frequent to

Make you wish you had a different occupation

Interfere with your relaxation after duty

Interfere with your sleep following flight

Interfere with your appetite

Make you want to go to bed early

Make you feel irritable with your air and ground crew,  
flight controllers, etc.

Make you wish you could abort a sortie

Impair your concentration during flight

Distract your attention during flight

Do you know of any instance where backache, or fatigue due to backache or  
pain, resulted in a dangerous, or potentially dangerous, situation during  
flight?

Yes

No

Do you think aircrew seats, in general, are very comfortable

Reasonably comfortable

Uncomfortable

Need to be improved

Need a great deal of improvement

Have you any further comments?