Recurrent and Transient Spinal Pain Among Commercial Helicopter Pilots

Knut Andersen; Roald Baardsen; Ingvild Dalen; Jan Petter Larsen

OBJECTIVE: The aim of this study was to provide information on the occurrence of spinal pain, i.e., low back and neck pain, among commercial helicopter pilots, along with possible associations between pain and anthropometric and demographic factors and flying exposure.

METHODS: Data were collected through a subjective and retrospective survey among all the 313 (294 men, 19 women) full-time pilots employed by two helicopter companies. A questionnaire was used to assess the extent of spinal complaints in a transient and recurrent pain pattern along with information on physical activities, occupational flying experience, and airframes.

RESULTS: The survey had 207 responders (194 men, 13 women). The pilots had extensive flying experience. Spinal pain was reported by 67%. Flying-related transient pain was reported among 50%, whereas recurrent spinal pain, not necessarily associated with flying, was reported by 52%. Women experienced more pain, but sample size prevented further conclusions. Male pilots reporting any spinal pain flew significantly more hours last year (median 500 h, IQR 400–650) versus men with no pain (median 445 h, IQR 300–550). Male pilots with transient or recurrent spinal pain did not differ from nonaffected male colleagues in the measured parameters.

CONCLUSION: Spinal pain is a frequent problem among male and female commercial helicopter pilots. For men, no significant associations were revealed for transient or recurrent spinal pain with age, flying experience in years, total hours, annual flying time, type of aircraft, or anthropometric factors except for any spinal pain related to hours flown in the last year.

KEYWORDS: low back pain, neck pain, occupational exposure, rotary wing, female pilots.

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In the Western world, spinal pain, i.e., pain from the lower back and neck, is among the most costly and disabling medical conditions. The lifetime prevalence of spinal pain has been reported as high as 54–80%. Low back pain (LBP) and neck pain with a prevalence of 23% and 15% are the main locations of spinal pain.[14] Neck and LBP conditions are linked to psychosocial factors where job autonomy and satisfaction are the most influential,[13] but also work-related physical factors might provoke such pain.[12]

Among helicopter pilots, low back[12] and neck pain[10] are reported to be more frequent than in the general population. Prevalence of LBP in the adult population in Canada and America is 18% and 26% and worldwide among helicopter pilots is 61–80%. Accordingly the point prevalence of neck pain among the adult population in Canada and the United States is 15% and 14%, and is reported to be 29% among Australian helicopter pilots.[10] The frequency of pain and the symptomatic presentations of pain patterns seem related to flight hours per day, exposure of total hours flown, and flying experience in years.[9,18] In addition, ergonomic issues in the cockpit, along with whole body vibration exposure, duration more than magnitude, of the airframes, as well as posture during flight, are suggested as explanatory factors.[2,7,12] In addition, individual physical factors such as BMI[25] and physical height may be influential.[16]

A previous study showed that 72% of army helicopter pilots suffered from LBP during and after flight, but only 10% reported the pain to last beyond 48 h after landing.[23] Chronic pain is usually defined to last beyond 3-6 mo.[14] Studies involving

From The Norwegian Centre for Movement Disorders, Stavanger University Hospital, Stavanger, Norway.

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Address correspondence to: Knut Andersen, The Norwegian Centre for Movement Disorders, Stavanger University Hospital, PB 8100, N-4068 Stavanger, Norway; knut.andersen@sus.no.

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helicopter pilots, however, seldom define how chronic complaints were diagnosed aside from describing it as unrelieved by cessation of flying,[6] exhibiting radicular features, or lasting for more than 2 wk.[2] According to the Guidelines from the Naval Aerospace Medical Institute, military pilots are grounded if pain is not alleviated within 10 d of medical treatment.[19] Similarly, a study showed that 57% of helicopter pilots reported pain during flights, with 3% still having complaints 48 h later.[5] These complaints may represent a risk factor for the development of chronic pain and a potential risk for sick leave and early retirement.[2] It may also affect flying performance.[7]

Findings from previous studies regarding the prevalence of chronic recurrent pain among helicopter pilots are not clear. One study reported that 24% of civilian pilots and 12% of military pilots experienced spinal pain episodes lasting more than 1 mo.[3] A Norwegian study reported that 4 of 39 pilots had pain duration longer than 2 d.[9] In one study, 25% of the pilots reported pain "at least once a week," indicating some chronicity or recurrent pain patterns.[25] Most studies of occurrence and factors related to spinal pain in rotary wing aircrew involves military populations with a relatively low number of sorties, low number of total and annual flying hours, and a low number of years of flying experience.[2,19,25] Commercial and civilian helicopter pilots servicing offshore industries often have more sorties, more frequently, and with longer durations than military pilots.[6]

A small explorative study of commercial helicopter transportations involving 22 male pilots in the North Sea out of Aberdeen, UK, reported a 12-fold increase in LBP and a doubling of headaches after 4-5 daily trips to service North Sea oil rigs. Factors claimed to influence these findings were duration of flying trips, vibration exposure, and thermal variations in cockpit and weather conditions, with turbulence over the rig at the landing site.[6] Airframes involved in this study were the Aerospatiale Tiger, Bell 214ST, and Boeing Vertol BV234. To obtain more information on issues related to spinal complaints among commercial pilots, we have examined the frequency and associated demographic factors of subjective spinal pain among civilian helicopter pilots operating at oil installations in Norway.

METHODS

Subjects

Study subjects were recruited among all the 313 pilots (294 men, 19 women) full-time employed and actively working from the two largest commercial helicopter companies in Norway, Bristow Norway and Canadian Holding Company. The two companies are located at five bases from Stavanger in the south to Hammerfest in the north. The invitation package included information on the study, an informed consent sheet, a questionnaire about subjective spinal pain, i.e., neck and LBP, and a prepaid self-addressed return envelope to the research group. Data were collected during March-June 2013. Western Norway Regional Committee for Medical and Health Research Ethics approved the study protocol (REK Vest 2010/2254). In total 242 (227 men, 15 women) (77%) of 313 pilots returned the questionnaires and consented to participate in the study.

In the period from October 2012 until August 2013 the airframe EC225 was grounded worldwide due to technical difficulties and pilots operating this aircraft were excluded due to lack of normal expected flying hours. We also excluded newly employed pilots with zero flying time in large helicopters. Thus, 207 (194 men, 13 women) pilots were included in this study.

Spinal pain is related to the vertebral column and its adjoining parts and, in this study, specifically in the neck and low back. Several studies[2,5,7] define spinal back pain among helicopter pilots as transient and chronic. Transient pain, related to flying exposure, is characterized as temporary, dull, and nonradiating in nature. This pain has onset during flying and ceases some time after flying. Chronic pain is more radiating in nature and not necessarily related to flying. In this study we applied de Vet's[4] definition of recurrent pain, not restricting it to low back only, by asking about two or more episodes of spinal pain, lasting for more than 24 h, during the last 12 mo, preceded and followed by at least 1 pain-free month.

Canadian Holding Company operates with three large type helicopters: the Eurocopter AS 332 L/L2 Superpuma, the Eurocopter EC 225 Airbus, and the Sikorsky S92. Bristow Norway operates two types: the Eurocopter EC 225 Airbus and the Sikorsky S92. Large helicopters have 2 pilots, carry 18 passengers or more, and are equipped with 4 or 5 rotor blades. Medium and small sized helicopters may have 1 or 2 crewmembers, carrying from 0 to 13 people, and have 2-4 blades. This study, due to the grounding of the EC225, only involves the two airframes, AS332 and S92. Neither of these airframes [AS332 and S92 (with six anti vibration generators)] exceeds the European Directives action levels for safety regarding whole body vibration exposure during an 8-h working day.[11]

Questionnaires

The questionnaires on personal experience of spinal pain included information on age, sex, height, weight, name of commercial company, and base location. Questions related to flying comprised: years of flying experience, total number of flying hours in helicopter, type or types of helicopters presently operated, number of flying hours in "large" offshore-helicopters, and hours flown in the last year. The survey comprised questions regarding physical activity, such as type of exercise programs of more than 30 min duration, frequencies of workouts per week, and any participation in organized training with description of type. In addition, questions of specific, specially designed exercises for neck and/or low back were included.

Questions regarding occurrence of spinal pain (neck and/or low back) included if the pilots, regardless of flight duration, 1) were bothered with spinal pain during at least one of three sorties during the last month, and 2) if the pilots over the last 12 mo had experienced at least two episodes of spinal pain of at least 24 h duration preceded and followed by at least 1 pain-free month.[4]

Procedures

Utilization of the internal postal service of the two companies secured the delivery and distribution of the questionnaires with an invitation to participate to all 313 pilots (294 men and 19 women). Although the combined workforces in the two companies are multinational, they were all able to read, understand, and answer the questionnaires. The pilots' personal medical records were not available to the research group, nor did we have any information regarding pregnancy status at the time of the survey. The pilots in this study were not using night vision goggles.

Statistical Analysis

All statistical analysis was performed in IBM SPSS Statistics version 22. Descriptive statistics of clinical and demographic factors are presented as means and SDs for symmetrically distributed continuous variables, as medians and interquartile ranges for skewed continuous variables, and as numbers and percentages for categorical variables. Furthermore, comparisons of the same factors between pilots with/without pain were performed using Student's *t*-tests (with Welch correction for heteroscedasticity when appropriate), Mann-Whitney nonparametric tests, and Pearson Chi-square tests, respectively. The occurrence of pain within various groups of pilots is presented in bar charts, including 95% confidence intervals for the estimated proportions. A P-value ≤ 0.05 was considered statistically significant.

RESULTS

The study includes 207 pilots (194 men, 13 women). **Table I** shows that the study population had a mean age of 40.6 yr. Combined they have 1.25 million flying hours ranging from 1000 to 24,500 h in helicopters. They also have more than 850,000 h in large types of personnel transporting helicopters. Furthermore, 92% of the helicopter pilots were physically active and 178 were doing at least two workouts per week of more than 30 min duration. As many as 41% of the pilots were doing specific low back exercises. Only 11% were doing specific exercises for the neck region.

There were 103 pilots (50%) (95 men, 8 women) who complained of transient spinal pain in at least 1 of 3 sorties last month. There were 107 (52%) (97 men, 10 women) who reported having experienced two or more episodes of recurrent spinal pain over the last year. Among all pilots, 35% suffered from both a transient and recurrent pain pattern. A mere 33% reported no spinal pain. The women were younger than the men [mean age 34.2 vs 41.0 yr, $t(18.597) = 4.97$ $P < 0.001$], had less flying experience (median total hours 3000 vs. 5450, $U = 633$, $P = 0.003$), and had more spinal pain in general [92% vs. 65% any pain, $\chi^2(1) = 4.104$, $P = 0.043$].

Table II shows clinical and demographic characteristics of male pilots with and without transient, recurrent, or any spinal pain. The number and power of the data prevented a similar table for female pilots. As can be seen from Table II, male pilots with spinal complaints are mostly similar to those without. Mean difference in age was −1.3 yr (95% confidence interval from −4.0 to 1.4) between pilots with vs. without spinal pain. Correspondingly, mean difference in height was 1.4 cm (−0.4 to 3.1), in weight −1.7 kg (−4.0 to 2.8), and in BMI $-0.6\ \mathrm{kg \cdot m^{-2}}$ (−1.4 to 0.3). None of these differences were rendered statistically significant and, deeming by the confidence intervals, none of the anthropometrical factors are important in predicting who suffers from spinal pain.

Regarding flight related factors, such as years, hours, and airframe, male pilots with transient or recurrent spinal pain did not differ significantly from the nonaffected pilots. The pain free pilots had more flying experience than those with spinal pain, but not significantly so. In contrast, pilots with any spinal pain flew more hours last year (median hours 500 vs. 445, $U = 3366.5$, $P = 0.014$). **Fig. 1**, **Fig. 2** , and **Fig. 3** illustrate these findings further for physical height, flying hours in the last year, and total flying hours.

DISCUSSION

This study suggests that recurrent and transient spinal pain are frequent among commercial helicopter pilots. We have examined several factors suggested to contribute to the increased frequency of spinal complaints among pilots. However, among the male pilots, we could not find any pilot-related factors or flying exposure, including airframes, which were associated with recurrent or transient spinal pain. The only association we found was between any spinal pain and flying hours during the last year. Concerning female helicopter pilots, we cannot draw such conclusions due to the small sample size. Our findings may have implications for development of strategies to reduce these complaints.

Spinal pain is a major public health problem. Previous studies have shown that helicopter pilots have more such complaints than the general population.[2,10,12] This includes both transient pain related to piloting and spinal pain in general. Transient pain, primarily thought to be a temporary occupational distress, and in this study defined as pain on at least one of three sorties last month, was reported by 50% of the pilots. Taken together, this study and previous reports underline that transient spinal pain is a major complaint both among military and civilian helicopter pilots.

In this study, we did not regard chronic spinal pain to be relevant for these actively working pilots. Still, we wanted to examine the frequency of spinal complaints beyond transient pain and chose to include information on recurrent pain as defined by de Vet.[4] The prevalence of chronic recurrent pain among pilots is not clear. In this study of commercial pilots, 52% experienced a recurrent spinal pain pattern as defined by having at least two or more episodes of spinal pain during the last 12 mo preceded and followed by one pain-free month. Thus, it seems that recurrence and chronicity is more dominant among civilian pilots than in their military counterparts. This may be caused by the fact that civilian pilots generally are older,

Table I. Demographic and Clinical Data for Helicopter Pilots Participating in the Study.

	ALL PILOTS (N = 207)	MEN (N = 194)	WOMEN (N = 13)
Anthropometry, mean (SD)			
Age	40.6 (8.5)	41.0 (8.6)	34.2 (4.5)
Height, cm	180 (6.8)	181 (5.9)	167 (4.5)
Weight, kg	83.4 (11.7)	84.6 (10.7)	64.9 (11.0)
BMI	25.6 (2.8)	25.8 (2.7)	23.4 (4.2)
Flying experience, median (IQR)			
Years	13.0 (8.0, 20.0)	14 (8.0, 20.0)	9.0 (6.0, 12.0)
Total hours	5000 (3300, 8000)	5450 (3300, 8000)	3000 (2165, 4150)
Total hours in large helicopter	3100 (1900, 6000)	3200 (1975, 6000)	2300 (1300, 3550)
Hours last year	500 (350, 630)	500 (371, 630)	400 (200, 600)
Mean annual flying hours	391 (325, 480)	400 (329, 489)	333 (285, 409)
Airframe operated			
AS 332 L/L2	42 (20%)	39 (20%)	3 (23%)
S-92	165 (80%)	155 (80%)	10 (77%)
Physical activity			
Regular physical activity	190 (92%)	179 (92%)	11 (85%)
Low back exercises	85 (41%)	80 (41%)	5 (39%)
Neck exercises	23 (11%)	22 (11%)	1 (8%)
Spinal pain			
Transient spinal pain	103 (50%)	95 (49%)	8 (62%)
Recurrent spinal pain	107 (52%)	97 (50%)	10 (77%)
Both	72 (35%)	66 (34%)	6 (46%)
Any	138 (67%)	126 (65%)	12 (92%)

Results given as counts (percentages) unless otherwise stated. N = 207.
Airframes; Eurocopter AS332L/L2 Superpuma and Sikorsky S-92 are large personnel transporting helicopters carrying 18-19 passengers and a crew of 2 pilots. Bristow Norway does not operate the AS332L/L2. Transient pain: spinal pain in at least one of three sorties in the last month. Recurrent pain: at least two episodes of spinal pain of 24 h duration, preceded and followed by 1 pain-free month. IQR = Interquartile ranges.

have longer experience in flying years, and have more sorties or a higher number of total flying hours.[2,3]

Over the years several factors have been suggested and investigated to uncover the cause for the increased frequency of spinal pain among rotary air wing crew. Helicopter-related factors such as total flying hours, type of airframe, whole body vibration, ergonomic construction of the cockpit, design of crew seats with adjustments options and upholstery, as well as body-mounted equipment have been suggested. Pilot-related factors such as age, height, and BMI have also been investigated. Data regarding female pilots warrants further studies.

In this study, as in line with most other studies, we found that pilot-related factors, like height, weight, or BMI, in male pilots only, did not relate to the occurrence of spinal pain.[2] One previous study indicated BMI[25] as a significant finding while others did not find this association.[2] A study involving 554 U.S. Navy rotary wing pilots reported an association between in-flight LBP and physical height above 180 cm.[16] The present study suggests that physical height is not a strong predictor for spinal pain in general.

An association between flying hours and spinal pain has been reported in several studies.[2,9,16] In this study, we found a significant association between any form of spinal pain and flying hours last year. We did not find any other factors explaining spinal pain in male pilots as such. Male pilots with or without transient or recurrent spinal pain reported no differences regarding total experience in flying years, total flying hours, hours flown in the last year, annual flying time, or flying time per day. Nor were there any differences in findings related to the two involved airframes. In analyzing only male helicopter pilots with more than 15 yr in the cockpit, 49/78 (63%) experienced pain, on par with 77/116 pilots (66%) with less or equal number of flying years (P = 0.610). Also, in considering pilots with more than 6000 total flying hours, 49/79 (62%) experienced pain, as were 77/115 (67%) pilots with equivalent or fewer total flying hours (P = 0.479).

Whole body vibration, linked to total flying hours, has been suggested as a cause of spinal pain.[2,12] Recent studies[8,11] question this relationship. In addition, modern aircraft have lower degrees of vibration in both frequency and amplitude.[7] Sitting position on its own is in general not associated with the development of occupational LBP, and neither is prolonged sedentary sitting.[12] Awkward, nonsedentary sitting, especially during flights, could be contributory.[7,12,18] However, today's autopilot systems permit a less rigid posture in piloting during cruising time.

Still, the effects of sitting in a constrained, restricted, and less ergonomically favorable working environment are not clear.[7,9] The mandatory body-mounted gear for survival and safety adds to the limitations in variation and adaptation during sitting and may also be a contributory factor.[7] Pilot seats are constructed for the protection of the pilot, with a high standard for crashworthiness, and one study listed the seat as the third most important reason for LBP due to insufficient lumbar support and thin seat-padding.[19]

These issues could be relevant for spinal pain, as axial load with compression and vertical spinal creep affects the viscoelastic intervertebral discs, the passive ligamentous structures of the spine,[17] and impairs the sensorimotor control mechanisms and thereby reduces the muscle protection of the underlying spine.[21] In line with this, U.S. research agencies called in 2011 for computational models to understand spinal pain for pilots, emphasizing inertial and task position stressors such as seating, cockpit geometry, and types of equipment.[15]

In contrast, other studies suggest that strategies to encourage the individual pilot to do exercises in order to master the environment may be more fruitful.[8,18] In the present study, pilots had a high regard for physical exercise. However, the training seems mostly general instead of focused toward problems associated with spinal pain. Whether the pilots in this study performed the specific neck and back exercises from a general health perspective or as part of a preventive or treatment regimen is not known. Specially designed exercise programs for

Table II. Demographic and Clinical Data for Male Helicopter Pilots With and Without Spinal Pain, and With and Without Transient and Recurrent Pain.

	PAIN (N = 126)	NO PAIN (N = 68)	P*	TRANSIENT PAIN (N = 95)	NO TRANSIENT PAIN (N = 99)	P*	RECURRENT PAIN (N = 97)	NO RECURRENT PAIN (N = 97)	P*
Anthropometry, mean (SD)									
Age	40.6 (7.8)	41.9 (9.8)	0.344	40.5 (7.9)	41.5 (9.1)	0.388	40.6 (7.8)	41.4 (9.2)	0.552
Height, cm	181.5 (5.9)	180.1 (5.8)	0.121	181.8 (5.9)	180.3 (5.9)	0.087	181.4 (6.1)	180.6 (5.7)	0.352
Weight, kg	84.4 (9.9)	85.0 (12.1)	0.746	85.0 (9.9)	84.2 (11.5)	0.609	84.3 (9.9)	84.9 (11.6)	0.709
BMI	25.6 (2.3)	26.1 (3.2)	0.199	25.7 (2.3)	25.9 (2.9)	0.671	25.6 (2.2)	26.0 (3.1)	0.272
Flying experience, median (IQR)									
Years	13.5 (8.0, 20.0)	15.0 (8.0, 21.8)	0.779	13.0 (8.0, 20.0)	15.0 (8.0, 20.0)	0.738	13.0 (8.0, 20.0)	15.0 (8.0, 21.0)	0.446
Total hours	5000 (3475, 8000)	5750 (3050, 8875)	0.726	5000 (3500, 8000)	5800 (3000, 9000)	0.677	5000 (3300, 7900)	5700 (3400, 8750)	0.567
Total hours in large helicopter	3150 (2000, 6000)	3750 (1800, 6000)	0.622	3100 (2000, 6000)	3500 (1800, 6000)	0.667	3100 (2000, 6000)	3400 (1800, 6000)	0.541
Hours last year	500 (400, 650)	445 (300, 550)	0.014	500 (400, 630)	500 (300, 630)	0.122	500 (400, 650)	500 (335, 600)	0.081
Mean annual flying hours	394 (321, 489)	403 (348, 495)	0.478	400 (321, 480)	400 (333, 500)	0.470	400 (330, 493)	400 (327, 490)	0.776
Airframe operated									
AS332L/L2	24 (19%)	15 (22%)	0.618	18 (19%)	21 (21%)	0.694	17 (18%)	22 (23%)	0.370
S-92	102 (81%)	53 (78%)		77 (81%)	78 (79%)		80 (82%)	75 (77%)	
Physical activity									
Regular physical activity	118 (94%)	61 (90%)	0.326	89 (94%)	90 (91%)	0.469	92 (95%)	87 (90%)	0.179
Low back exercises	55 (44%)	25 (37%)	0.353	42 (44%)	38 (38%)	0.410	41 (42%)	39 (40%)	0.771
Neck exercises	17 (14%)	5 (7%)	0.198	12 (13%)	10 (10%)	0.578	13 (13%)	9 (9%)	0.365

Results given as counts (percentages) unless otherwise stated. N = 194.

Airframes: Eurocopter AS332L/L2 Superpuma and Sikorsky S-92 are large personnel transporting helicopters carrying 18-19 passengers and a crew of 2 pilots. Bristow Norway does not operate the AS332L/L2. Spinal pain: transient and/or recurrent pain. Transient pain: spinal pain in at least one of three sorties in the last month. Recurrent pain: at least two episodes of spinal pain of 24 h duration, preceded and followed by 1 pain-free month.

*P-value from either Student's t-test (with Welch correction when appropriate) comparing means, Mann-Whitney test comparing distributions of flying experience nonparametrically, or from Pearson Chi-square test comparing proportions, between pilots with vs. pilots without spinal pain. IQR = Interquartile ranges.

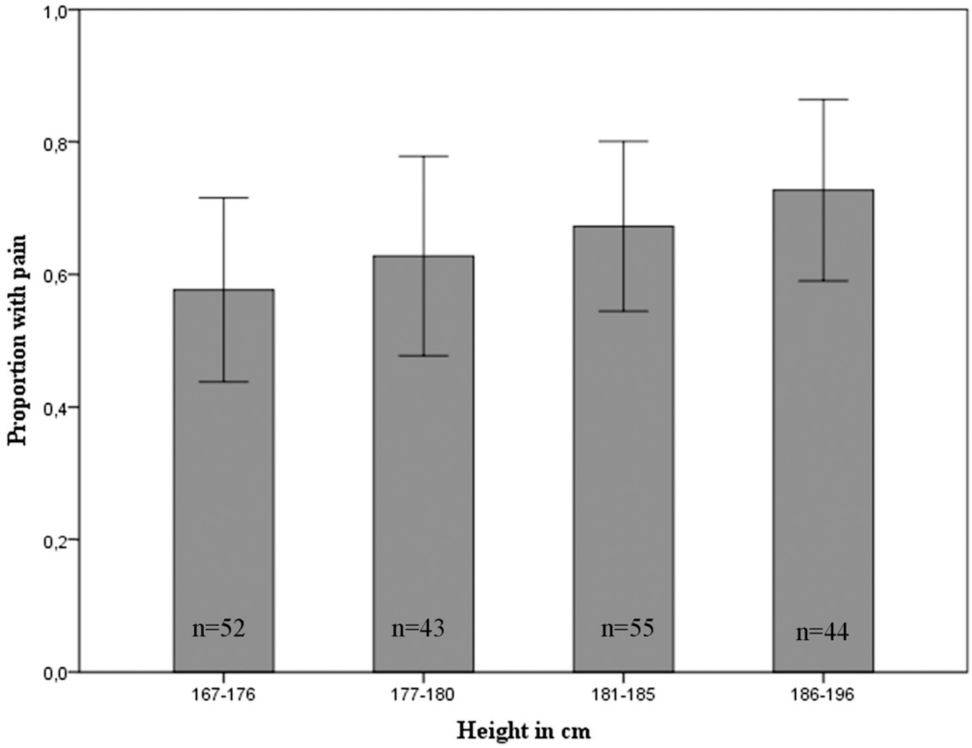

Fig. 1. Physical height and any spinal pain among male helicopter pilots ($N = 194$). The error bars represent 95% confidence intervals for the proportion of pilots with pain within each height group.

military personnel in order to increase endurance and stability in the cervical and lumbar spine have been implemented.[10,18] This is especially aimed at pilots using night vision goggles and, in particular, to female pilots, who are perceived to be more susceptible to injury due to differences in neck strength and flexibility compared to men.[10] The results from these studies suggest a shift in strategies from only focusing on the physical working environment toward the development and implementation of focused training programs for the spinal structures on a regular basis. The effect of physical conditioning programs to reduce sick leave in workers with back pain are uncertain. There is a small short-term effect (≤ 1 yr) for chronic pain, but no effect after 2-3 yr.[22] The effects of physical training are perishable and must, therefore, be performed according to principles of periodization, progressive overload, and be sustained.[1] One study of workplace strength training of the upper spinal area adhered to these principles for 10 wk and prevented deterioration of work ability among manual workers.[24] Graded stabilizing exercises for patients still at work seems more effective than daily walks.[20] Thus, focused stabilizing exercises for spinal structures, performed continuously, may be essential in the prevention of transient and recurrent spinal pains associated with rotary wing piloting.

Helicopter pilots are medically examined on a frequent basis in order to maintain their license and are in general considered cognitively strong. It is a professional standard among pilots to monitor the number of flight hours. Yet recall bias may be an issue in a retrospective questionnaire based survey. The questionnaire, which inquired about spinal pain in a transient and/or recurrent pattern, elicited no information regarding pain locations, individual predisposing factors, or occurrence of spinal pain prior to, or during, the pilot's career at the time of the survey. The commercial pilots in this study have considerable aviation experience in both years

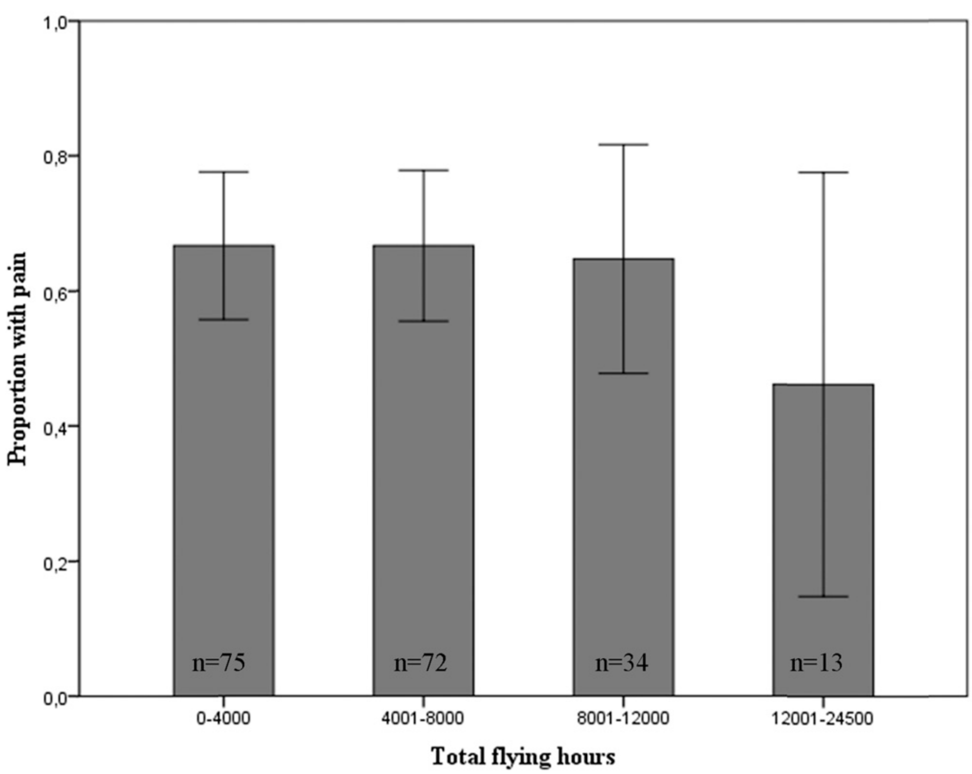

Fig. 2. Total flying hours and any spinal pain among male helicopter pilots ($N = 194$). The error bars represent 95% confidence intervals for the proportion of pilots with pain within each group of total flying hours.

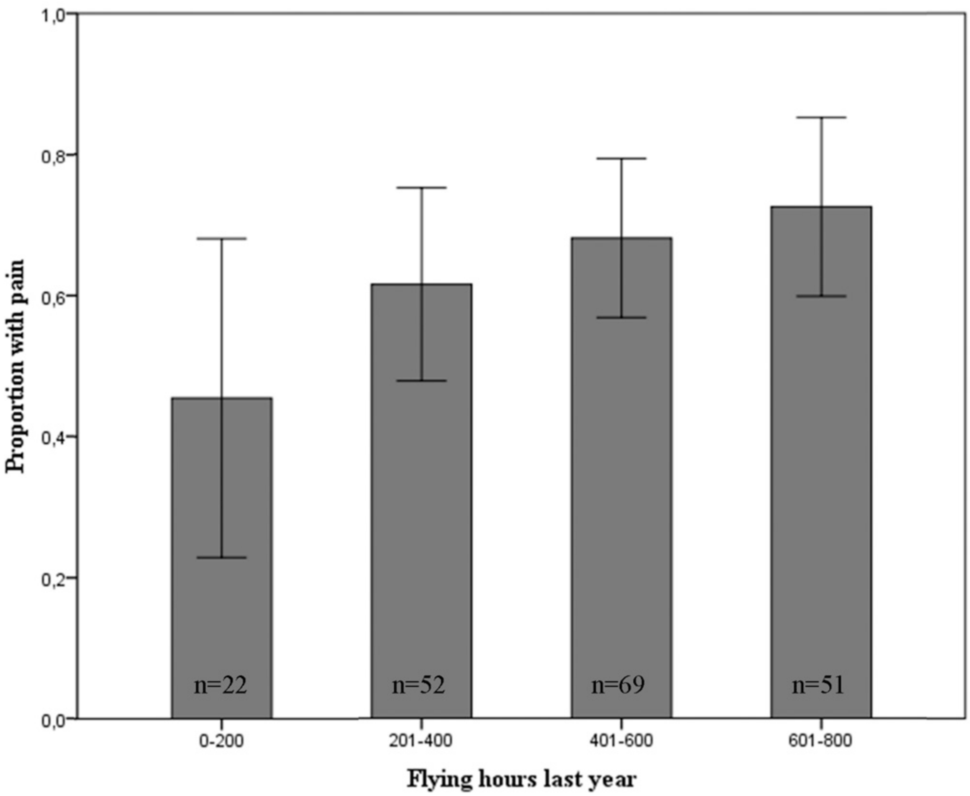

Fig. 3. Flying hours in the last year and any spinal pain among male helicopter pilots ($N = 194$). The error bars represent 95% confidence intervals for the proportion of pilots with pain within each group of hours flown last year.

and hours and the size of this study implies robustness and validity.

This being a cross-sectional study, there are several limitations to the kind of conclusions that can be drawn from the data, e.g., causal inference is prohibited. With a mostly long-lasting condition like spinal pain, there will be several behavioral patterns that may obscure possible causal relationships: for example, pilots with spinal pain may cut down on their flying hours, thus obscuring a possible causal effect of high number of flying hours on spinal pain. Low back and neck exercises may be helpful for preventing or treating spinal pain, and pilots with spinal pain may be motivated to do such exercises, but possible effects cannot be established in a cross-sectional study. Furthermore, we only had access to the people working as commercial helicopter pilots at the time of the study. There is a possibility that spinal pain has forced some pilots to change their jobs, i.e., the lifetime incidence of spinal pain among commercial helicopter pilots may be even higher than 67%.

Technological improvements of helicopters regarding ergonomics, vibration, seat construction, and adjustment options, along with advances in safety and survival equipment, must be encouraged. In addition, there are strong indications to introduce targeted exercise programs for spinal structures to reduce or prevent spinal pain. Such programs should be tested in randomized trials in order to document a possible reduction of complaints among helicopter pilots.

This study has shown that spinal pain, transient and recurrent, is a frequent problem among helicopter pilots with implications for personal and professional levels. Among the male helicopter pilots we could not find any significant associations for transient or recurrent spinal pain with age, flying experience in years, total hours, annual flying time, type of aircraft, or anthropometric factors except for any spinal pain related to hours flown in the last year. Concerning female helicopter pilots, we cannot draw such conclusions due to the small sample size. However, we acknowledge that female pilots, with less flying experience in hours and years, report higher rates of recurrent and transient spinal pain. These findings among female pilots warrant further research.

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Authors and affiliations: Knut Andersen, DC, Ingvild Dalen, Ph.D., M.Sc., and Jan Petter Larsen, M.D., Ph.D., The Norwegian Centre for Movement Disorders, and Roald Baardsen, M.D., D.D.S., Department of Neurosurgery, Stavanger University Hospital, Stavanger, Norway.

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