Characterization of Low Back Pain in Pilots and Maintenance Technicians on a Commercial Airline

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INTRODUCTION: Lower back pain (LBP) is the most common complaint worldwide and the leading cause of disability in the workplace. In Colombia there are no epidemiological data on low back pain in aviation. This study aimed to characterize lower back pain in pilots and maintenance technicians in a Colombian commercial airline.

METHODS: Information was collected from the total population in a Colombian commercial airline in Bogota during the period from 2011 to 2013 using a voluntary survey which requested demographics, occupational (LEST survey) factors, back pain, and chronic pain (chronic pain grade scale).

RESULTS: The prevalence rate of LBP in pilot respondents was 71% and the factors associated previously have belonged to the military forces: occupational exposure to physical load and work time. Chronic low back pain was at a prevalence of 49%. The prevalence of LBP in maintenance technicians was 65%. Associated factors were again similar to military forces and included mental workload. Chronic pain had a prevalence of 65%. Factors associated with chronic low back pain were the technicians' time in office and physical load.

DISCUSSION: The prevalence of lower back pain in pilots is similar to that presented in the airline world population. In the case of maintenance technicians, the prevalence was higher than those found in other similar groups, but very similar to prevalences presented in different business industries, including the transport sector.

KEYWORDS: lumbar pain, chronic pain, occupational, aircrew.

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Low back pain (LBP) is the most common musculoskeletal disorder in the general population, with an estimated prevalence of approximately 60–80% in industrialized countries. It is the principle cause of morbidity and disability in active workers, and approximately 90% of acute cases become chronic. Its etiology is multifactorial and includes occupational and nonoccupational factors, such as the following: age, cigarette smoking, physical activity, anthropometric measurements, medical history, lumbar mobility, structural abnormalities, posture, and exposure to vibrations, among others.[2,13,14] For these reasons, it is the most common medical cause of work disability.[1]

In the aeronautical environment, musculoskeletal disorders are the most common discomforts and cause disabilities in commercial pilots, even more than cardiovascular disease. It is estimated that the prevalence of back pain in pilots is close to 80–83%.[6,7] Among the associated risk factors are sustained postures, repetitive movements, overloading, vibrations, trauma, psychosocial factors, and being overweight or obese.[3,8]

The prevalence of changes in the cervical spine is more common in helicopter pilots, at up to 19%, compared to 8–13% among pilots of other aircraft and 10% among air traffic controllers. Compression fractures in the lumbar region are predominant. A higher prevalence of cervical changes has been found with increasing age and stature, with vertebral fractures or spondylosis changes in jet pilots.[2]

In Colombia, the Ministry of Social Protection reports that back pain ranks in second place among occupational diseases, with a 14% incidence rate.[4] Although information on LBP in the aviation environment is limited, a study was conducted at

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the National University of Colombia by a physiotherapy team that found a prevalence of 59% in military aviation personnel.[4] However, in civilian aeronautics, there is no clear data. For that reason, through this study, we sought to characterize this disease in pilots and maintenance technicians in a Colombian commercial airline.

METHODS

This paper reports a descriptive cross-sectional study in which we sought to determine the prevalence of LBP and risk factors associated with its presence and chronicity. The total subjects of pilots and ground maintenance personnel were taken from a Colombian commercial airline between 2011 and 2013. The inclusion criteria included pilots and ground maintenance personnel who were working during that period, who agreed to participate, and who gave informed consent. The exclusion criteria excluded personnel who did not agree to voluntary participation in the study or did not completely fill out the form. A voluntary and anonymous survey with three components was conducted: 1. personal information, which inquired about age, anthropometric measurements, length of service, flight time, previous work, pathologies and medication history, tobacco habit, physical activity, presence of LBP, and medical treatment received; 2. the chronic pain grade scale (CPGS), which objectively describes the intensity and disability caused by pain, classifying it into five chronic groups ranging from no pain or disability to high pain intensity and disability, validated in multiple studies;[26] and 3. the LEST observation questionnaire, a tool that performs a comprehensive diagnosis of a job to indicate whether each of the scenarios considered is satisfactory, annoying, or harmful. It rates five dimensions: physical environment, physical load, mental load, psychosocial aspects, and cumulative work experience. Data were stored in a database in Microsoft® Excel® 2010. The LEST questionnaire responses were recorded in the database software using the LEST method, which can be found at http://www.ergonautas.upv.es/metodos/lest/lest-ayuda.php. Once the scores were obtained, they were analyzed using Epi Info™ 7.0 software by establishing frequencies for the qualitative and quantitative variables and correlation statistics.

RESULTS

Out of 135 workers, including air and ground personnel, 111 agreed to participate, of whom 59 were pilots (44 rotary-wing, 15 fixed-wing aircraft) and 52 were ground personnel. Of the 59 pilots, 38.9% were pilots in command, 57.6% were copilots, and 3.3% were flight instructors (**Table I**). They had a mean age of 40 yr and an average of 4706 flight hours, with a range from 480 h to 20,000 h. Of the 52 ground personnel, 96.1% were maintenance technicians and 3.85% were inspectors. They had a mean age of 40 yr and the average cumulative work experience was 15 yr, ranging from 1 mo to 38 yr.

Table I. Demographic Characteristics of the Population of Pilots and Ground Personnel (GP).

VARIABLES	PILOTS NO. (%)	TECHNICAL GP NO. (%)
Body Mass Index (BMI)		
Normal	24 (40.6)	11 (21.1)
Overweight	28 (47.6)	35 (67.3)
Grade I Obesity	6 (10.7)	6 (11.5)
Grade II Obesity	1 (1.69)	0 (0.0)
Military Service		
Yes	37 (66.1)	19 (36.5)
No	19 (33.9)	33 (63.4)
Tobacco Use		
Yes	44 (80.0)	3 (5.8)
No	11 (20.0)	48 (94.1)
Physical Activity		
None performed	15 (25.4)	25 (48.1)
Irregular	21 (35.5)	15 (28.8)
Regular	19 (32.2)	12 (23.0)
Not mentioned	4 (6.7)	0 (0.0)
Pathological Background		
Dyslipidemia	12 (20.3)	2 (3.8)
Spondylitis or arthropathies	1 (1.69)	1 (1.9)
Gastritis	2 (3.3)	1 (1.9)
Hearing loss	2 (3.3)	0 (0.0)
Hypertension (HTN)	4 (6.7)	3 (5.7)
Varicose veins	1 (1.6)	0 (0.0)
Refractive errors	5 (8.4)	0 (0.0)
Impaired glucose tolerance	0 (0.0)	1 (1.9)
Carpal tunnel syndrome	0 (0.0)	1 (1.9)
None	32 (54.2)	45 (86.5)
Pharmacological Background		
Risk	6 (74.5)	1 (1.9)
No risk	9 (10.1)	6 (11.5)
No medications	44 (15.2)	45 (86.5)

The prevalence of LBP was 71.1% among pilots, of whom 80.95% were rotary-wing pilots and 19.05% were fixed-wing pilots. The percentage who consulted a doctor for the pain was 32.2% and, of these individuals, 37.9% received some form of therapeutic intervention, such as physical therapy, strengthening exercises, or analgesics. Among ground personnel, the prevalence of LBP was 65.3%. The percentage who consulted a doctor for the pain was 34.6% and, of these individuals, 15.3% received treatment in the aforementioned categories.

When evaluating chronic pain with the CPGS, 38.9% of pilots indicated LBP of low intensity with low disability (Grade I); 8.47% indicated high pain intensity with low disability (Grade II); and 1.69% indicated high pain intensity with high disability (moderate limitation, Grade III). The ground personnel indicated 44.2% LBP Grade I; 13.4% Grade II; and 7.69% Grade III.

In analyzing the LEST survey for the pilots group (**Table II**), the physical environment variable qualified as harmful due to noise and bright lights. For the ground personnel group, the variables that qualified as harmful were physical load, specifically due to static load (sustained postures), and the physical environment due to noise and bright lights.

Among both the pilots and ground personnel, a significant association was found between the occurrence of LBP and

Table II. Results of the LEST Questionnaire.

DIMENSIONS AND VARIABLES	PILOTS (%)	GROUND PERSONNEL (%)
Physical Load		
Noxiousness	1 (1.69)	31 (59.6)
Faint discomfort	4 (6.78)	6 (11.5)
Half annoyances	5 (8.47)	8 (15.3)
Strong discomfort	20 (33.9)	6 (11.54)
Satisfactory situation	29 (49.1)	1 (1.92)
Physical Environment		
Noxiousness	53 (89.8)	49 (94.2)
Faint discomfort	3 (5.08)	1 (1.92)
Half annoyances	0 (0.00)	0 (0.00)
Strong discomfort	1 (1.69)	1 (1.92)
Satisfactory situation	2 (3.39)	1 (1.92)
Mental Load		
Noxiousness	0 (0.00)	0 (0.00)
Faint discomfort	0 (0.00)	0 (0.00)
Half annoyances	9 (15.2)	3 (5.77)
Strong discomfort	46 (77.9)	35 (67.3)
Satisfactory situation	4 (6.78)	14 (26.9)
Psychosocial aspects		
Noxiousness	0 (0.00)	0 (0.00)
Faint discomfort	0 (0.00)	0 (0.00)
Half annoyances	0 (0.00)	0 (0.00)
Strong discomfort	54 (91.53)	44 (84.6)
Satisfactory situation	5 (8.47)	18 (15.3)
Work Time		
Noxiousness	2 (3.39)	0 (0.00)
Faint discomfort	1 (1.69)	1 (1.92)
Half annoyances	17 (28.8)	19 (36.5)
Strong discomfort	21 (35.5)	31 (59.6)
Satisfactory situation	18 (30.5)	1 (1.92)

previous work in the military or public forces (OR = 3.65, CI = 1.0204–13.78, $P = 0.0383$; and OR = 7.7053, CI = 1.6917–56.248, $P = 0.005$). Additionally, for the pilots, there was a further association with physical load ($P = 0.0245$). Psychological aspects (OR = 0.0835, CI = 0.0031–0.728, $P = 0.0212$) were a factor constituting a protective tendency for workers. Another deleterious factor was cumulative work experience ($P = 0.008$). In both groups, there was no significant association with age, body mass index (BMI), type of piloted aircraft, job position, physical activity, physical environment, or mental load.

For the chronicity of pain, a positive association was found in the pilots group with high BMI ($P = 0.0006$), the job position of copilot ($P = 0.0001$), and flight hours ($P = 0.0117$). There was also a significant association between time on shift ($P = 0.001$) and physical load ($P = 0.0085$) in the chronicity of pain for ground personnel.

DISCUSSION

Globally, LBP is considered to be a significant public health problem in civilian and military pilots and ground personnel.[9,15,17] It was for this reason that the prevalence of back pain in the study population was originally discerned: it was 71% for both fixed-wing and rotary wing pilots. This result was similar to the prevalence reported worldwide, between 40% and 82%. The highest prevalence corresponds to rotary wing pilots[6,15,16] and is higher than reported in the study by the National University of Colombia (59.3%).[25] However, the population of that study included not only pilots but also artillerymen, flight engineers, flight technicians, and rescue workers.[4] Furthermore, the study was performed on military personnel, who are supposed to have higher fitness conditioning than civilian personnel, which may have decreased the prevalence of the pathology. The prevalence of LBP in technical personnel, at 65%, is higher than reported in studies of military populations that do not engage in flying duties (52%). In the literature studied, there was no data on civilian ground personnel, but this prevalence is in accordance with the values reported in studies of occupational health in various industries, including transportation, which are between 52% and 65%.[2,6,14,16]

The etiology of LBP has a multifactorial source, including individual, occupational, and psychosocial factors that contribute to its development. The cause of LBP differs between military and civilian pilots, apparently due to the type of mission.[18,22,24] However, pilots in general are often exposed to postural distortions over long periods of time, as well as to vibrations. Both of these factors are the most closely associated with the development of LBP.[18,22] Our study correlates with these results by finding a significant association between LBP and load, which includes static load (associated with positions) and dynamic load (associated with repetitive movements and transport of objects). In contrast to the studies mentioned above, this study found a significant association between history of work in the military or public forces and entry into commercial airlines, but found no significant association with other potential ergonomic factors, such as the physical environment and exposure to vibrations.

The current view indicates that multiple psychosocial factors contribute to the development and persistence of LBP. Previous studies found that job demands, control or the freedom of decision at work, and social support (labor relations, family, and even the relationship with the treating physician) are associated with LBP.[10,12,15] In contrast, in this study, it was shown that psychosocial factors (in this case, studying initiative, communication, command relationship, and social status) are protective. However, when the cumulative work experience (amount and organization of time) was analyzed, there was an association with the presence of LBP, although no categorical conclusion is possible because this point was not researched in depth.

In this study, we found that a history of working with the military or public forces was a factor associated with LBP in ground personnel, possibly due to the functions or hours of their old jobs. Another factor associated with the presence of LBP in maintenance technicians was mental load (time pressure, complexity, and focus), although there are no specific studies examining psychosocial aspects in aviation personnel without flying duties.

The Department of Human Engineering at the Institute of Aerospace Medicine for the Indian Air Force suggests that a small minority of crews with musculoskeletal disabilities exhibited a delay in the recuperation pattern, which is an important factor in determining when to return to any flying or employment or if the patient is permanently incapacitated.[21] These cases of chronic LBP in the aeronautical environment represent a challenge and are primarily related to psychosocial aspects concerning the circumstances of trauma and social support.[5,11,19] This factor could make the difference between recuperation from injury or permanent disability for workers and crews.[20,23] To examine the importance of the factors mentioned above, an article was published in 2010 in which the patterns of recuperation after crew personnel suffered musculoskeletal injuries were evaluated, and it was found that 28.1% of this population had delayed recuperation.[21] In our findings, 49% reported chronic pain that varied between LBP of low intensity with low disability (39%), high intensity with low disability (8%), and high intensity with high disability (moderate limitations) (2%). In the technicians group, 65% reported chronic pain, which could also vary between LBP of low intensity with low disability (44%), high intensity with low disability (13%), and high intensity with high disability (moderate limitations) (8%). These values are much higher than the results reported by the Indian Air Force, assuming that people who had delayed recuperation reported chronic pain, although chronicity is not mentioned specifically. The population in the previous study was military and our population is from civil aviation, which has fewer risk factors for developing LBP according to the literature.[22] Perhaps the difference between the percentages is that the study population of the Indian Air Force was in an integrated treatment program that included medical treatment, physical strengthening, and psychological support, among other factors.[21] However, in the population surveyed in the case of pilots, only 32.2% consulted a doctor for their ailment, with 6.9% receiving analgesic therapy, 6.9% receiving physical strengthening exercises, and 24.1% receiving physiotherapy. Among ground personnel, 34.6% consulted a doctor for their ailment, with 1.92% receiving analgesic therapy, 3.85% receiving strengthening exercises, and 9.62% receiving physiotherapy; however, it is not known whether they completed the treatment scheme.

The study may be limited by the subjective response of the respondents; no objective measure was taken to evaluate the presence of LBP or associated factors. In addition, the results and conclusions of this study cannot be extrapolated to the entire population of pilots or technicians of the Colombian commercial aviation industry because only one company was selected for this study. For that reason, the results and conclusions solely represent the survey population.

In conclusion, the prevalence of chronic pain in the population surveyed was 71% and 65% for pilots and ground personnel, respectively. The factors that were found to be related to the development of chronic LBP in pilots were flight hours, BMI, and the job position of the pilot (especially the copilot). In the technicians group, factors associated with chronic discomfort were time on shift and physical load (static and dynamic). These results were expected because with more flight hours and more time on shift, there was greater exposure to different occupational factors, which together with other individual factors can generate ailments in the lumbar region.[8,15,21] In addition, high BMI generates a higher burden in the lumbar region and personnel who are overweight or obese typically have poor muscle fitness, resulting in prolonged recuperation or relapse. In the pilots group, the job position of copilot presents a significant association with the development of chronic LBP and, although we cannot conclude the specific reason, this issue may be due to the overwhelming number of respondents who were copilots or may actually be a result of an overload of higher work functions in this group.

Finally, we believe that new studies should be performed which include a larger population to evaluate how the influence of types of schedules or shifts and specific functions of each of the groups of both air and ground personnel may influence the onset of LBP and its chronicity. The new studies should investigate the therapeutic effectiveness of providing direct recommendations for diagnosis and treatment of the disease, and prevention of its chronicity.

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