



## **Lower Back Pain Is a Common Complaint, But Precautionary Practices Help Pilots Cope**

*Some ailments may be the results of poor posture, stress,  
lack of exercise or improper design of work space.*

—  
*Stanley R. Mohler, M.D.*

Most people experience lower back pain sometime during their adult lives. In industrialized countries, more than 60 percent of the population admits to having had back pain.<sup>1</sup> In the United States, problems affecting the lower back are the leading cause of disability for people under age 45,<sup>2</sup> and in England, back pain is the leading cause of disability for people of all ages.<sup>3</sup>

Although data are not available on flight crewmembers with lower back pain, the numbers presumably are similar to those for the general population, and several studies — primarily involving flight crewmembers on military helicopters — have attempted to gauge the frequency of back pain among pilots.

The studies have found that:

- Of 131 Australian military helicopter pilots responding to a 69-question survey, 16 percent reported regular back pain associated with flying, 28 percent reported “back discomfort,” and 39 percent reported “occasional” back pain. Eighty-five percent of those who reported back pain while flying said that their ailment was related to flying,



and almost one-third said that flying was detrimental to their health;<sup>4</sup>

- Of 7,675 U.S. Navy flight crewmembers on helicopters and airplanes, 2.2 percent, or 171 crewmembers, were diagnosed with back problems. The most frequent diagnosis (44.4 percent) was intervertebral disk disorder, a category that includes slipped disks and degenerated disks. Other common diagnoses were dorsopathies, or back diseases (25.1 percent), and curvature of the spine (15.2 percent). Flight engineers were more likely than other crewmembers to have had diagnoses of back problems;<sup>5</sup> and,
- In-flight back pain occurs in 13 percent of all U.S. Navy pilots. The U.S. Naval Operational Medicine Institute determined that helicopter pilots report a greater incidence of back pain than pilots of other Navy aircraft, probably because helicopter pilots are exposed more often to aircraft vibrations.<sup>6</sup>

“Back pain is well-known, at least in the Western world, as being a widespread problem in all people,” said Claus

Curdt-Christiansen, M.D., chief of the International Civil Aviation Organization Aviation Medicine Section. “Pilots [like other] ... people who are confined to a sitting position [at work] are more vulnerable [to back pain].”<sup>7</sup>

Don Hudson, M.D., air medical adviser for the Air Line Pilots Association, International, said that, although back pain is a relatively common complaint among airline pilots, determining the source of the pain is difficult. Back pain could be related to any number of factors, including an individual pilot’s physical condition, posture and stress level; the pain is not necessarily job-related, Hudson said.<sup>8</sup>

“It’s hard to say [that a pilot’s back pain] is due to flying, as opposed to [the back pain experienced by] a doctor sitting at a desk,” Hudson said.

Nevertheless, a biomechanical analysis of the dimensions of pilot seats in five types of aircraft (Airbus A310, Boeing 737, Boeing 747-300, Boeing 747-400 [B-747-400] and McDonnell Douglas DC-10) said that the seats do not meet basic biomechanical design criteria.<sup>9</sup>

The analysis involved comparing the dimensions of the measured pilot seats with biomechanical and anthropometric standards (standards that involve the way a body moves to accomplish certain tasks and the precise measurement of various body parts). The measurements focused largely on the height and depth of seats, the height and depth of backrests, and the height of lumbar supports and armrests.

The analysis said that pilot seats generally could be made more comfortable by making portions of the seats flatter, raising lumbar supports, improving the adjustability of armrests and modifying the angle at which the seats are tilted.

Nevertheless, consideration of the biomechanical requirements is not the only factor in establishing criteria for comfortable seats, said Darcy Hilby, a Boeing engineer in the ergonomics group for design of the Boeing 777 (B-777). Hilby said that standards for pilot seats and observer seats on the B-777 were developed after interviews with pilots who fly transoceanic flights in Boeing 747-400s. The pilots were asked how comfortable the B-747 flight-deck seats were during long flights.<sup>10</sup>

“The outcome ... was that they thought the B-747-400 seats were pretty comfortable,” Hilby said.

As a result, design standards for B-777 seats were based on the B-747 seat design, also taking into consideration the requirements established by the U.S. Federal Aviation Administration that the seats be capable of withstanding certain forces in an accident, she said.

Ipeco Europe, which manufactured the pilot seats for the B-777, said that the seats include lumbar supports that can be adjusted vertically and horizontally; a seat-back with an

adjustable degree of recline; adjustable, stowable armrests; adjustable thigh supports; horizontal, vertical and lateral seat adjustments; and adjustable headrests.<sup>11</sup>

Regardless of the source of lower back pain, a number of precautionary practices, including proper exercise and proper posture, can help crewmembers prevent pain (see “Preventing Lower Back Pain”). Most precautions apply to people in all professions, not just to pilots, said Curdt-Christiansen, and pilots often are limited in their ability to implement one of the most useful methods of fighting lower back pain — changing position by standing or by going for a walk.<sup>12</sup>

Diana Cronan, a spokeswoman for the Air Transport Association of America, said that many airlines have taken steps to address ergonomic issues, including recommending isometrics and other exercises that pilots can do in their seats

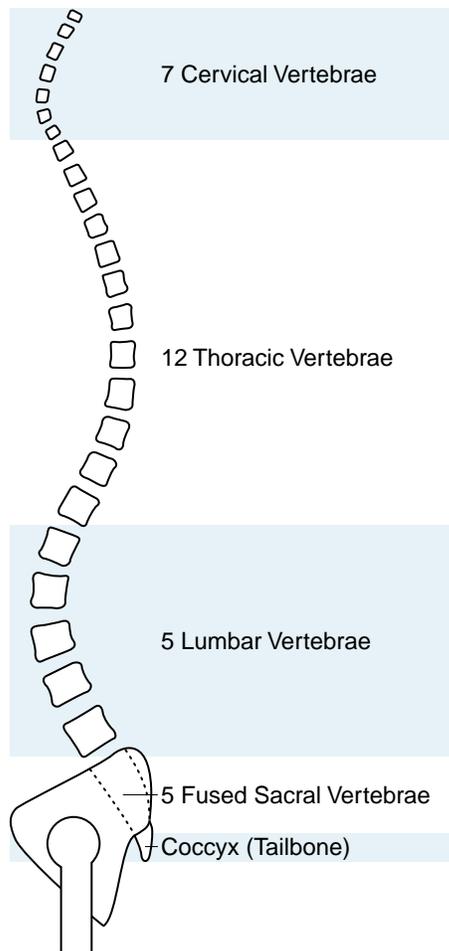
### Preventing Lower Back Pain

The following are recommendations for avoiding lower back pain:

- Exercise. A reasonable physical-conditioning program, along with flexibility exercises, will help strengthen the lower back;
- Maintain a weight that is in proportion to height;
- When lifting an object, keep the spine in a vertical position and squat near the object being lifted. Raise the object slowly, using the power of the legs — not the back — to accomplish the task. Before lifting an especially heavy object, stretch and flex the back muscles;
- When sitting, keep the spine relatively straight. Sit in a straight-backed chair that offers firm back support;
- When standing, place the feet as far apart as the shoulders. Periodically shift the weight from one foot to another;
- Sleep on a firm, flat mattress, on your side, with legs bent, and with a small pillow between the knees;
- When leaning forward, lean from the hips, not the waist, and keep the back and neck straight; and,
- If pain is experienced during lifting or some other movement, stop the activity.♦

— Stanley R. Mohler, M.D.

## Human Vertebral Column



Source: Stanley R. Mohler, M.D.

**Figure 1**

and supplying inflatable cushions to provide additional lumbar support.<sup>13</sup> Some airlines also have hired ergonomics specialists to advise pilots and other airline employees about how to perform their tasks and adjust their equipment in ways that will provide ergonomic benefits.

The back is supported by seven cervical vertebrae, 12 thoracic vertebrae, five lumbar vertebrae and five fused sacral vertebrae (Figure 1, page 3). At the lower end of the vertebral column is the coccyx, or tailbone, a unit of four small, fused vertebrae.

The lower back, or lumbar region, is the focus of postural forces when an individual stands, sits or lifts; therefore, most back problems are associated with the lower back.

Back problems can result from a single excessive-force injury or from the gradual accumulation of small injuries that coalesce so that their symptoms become apparent simultaneously. In

many instances, the back problems can be traced to improper methods of lifting, sitting, standing — or even sleeping.

Improper lifting consists of leaning forward to pick up an object and using the back muscles to assert the primary lifting power. This strains the lower back and presents the risk of damaging ligaments and tendons. The heavier the object being lifted and the greater the acceleration of the lifting motion, the greater the force through the back. The extra force being placed on the abdominal side of the intervertebral disks presents the risk of disk rupture to the rear. Proper lifting involves keeping the spine in a vertical position and squatting near the object, keeping the object close to the body and raising it by using the power of the legs. The possibility of injury can be minimized by spending a few minutes stretching, flexing and extending the back before lifting a heavy object.

Improper sitting — for example, slouching in a chair — puts bending forces on the front of the lower spine. Proper sitting involves maintaining a posture that assures a relatively straight spine. Proper sitting at a workstation — or on the flight deck — involves having aircraft controls, instruments and the general layout of the work area, including the seating structure, comfortably arranged for the individual operator.

The proper posture for standing involves placing the feet as far apart as the shoulders and periodically shifting the weight from one foot to another.

Improper reclining or sleeping positions place extra force on the lower back, and the problem is aggravated by sleeping on a mattress that is too hard or too soft. The bed should be relatively firm but should yield somewhat to the body.

Among pilots, back pain typically is experienced first as a dull ache in the lower back. The pain can increase in intensity if the pilot continues flying, and sometimes pain spreads to the thoracic vertebrae, the shoulders and the neck.

Although in many medical cases the causes of back pain cannot be determined, reports of lower back pain among New York Airways helicopter pilots were traced to the arrangement of the cockpit in their Piasecki helicopters.<sup>14</sup>

The helicopters originally were designed as single-pilot military aircraft and later modified for civilian use by installing two seats.

In 1968, six of the 12 pilots who flew the helicopters filed for medical disability because of back problems; some of the other six pilots also had experienced back pain. Observations of their flights revealed that anti-torque pedals for the two flight crewmembers were offset toward the midline of the cockpit so that the pilots had to turn their bodies to operate the pedals. The twisting force on the spine was aggravated by other movements needed to operate the cyclic and the collective.

Additional forces were imposed by undamped vibrations through the cockpit seats.

Because of flight schedules that involved shuttling airline passengers among the three airports serving metropolitan New York, New York, U.S., and a New York office building owned by Pan American World Airways, crewmembers typically conducted several takeoffs and landings every hour, and they had little opportunity during the workday to leave the cockpit to stretch their back muscles or to exercise in any other meaningful way.

The problems were corrected by the introduction of new equipment — helicopters with anti-torque pedals centered in front of each pilot and with a decreased level of seat vibration. Within weeks, the ailing pilots had stopped experiencing back pain.

In recent years, airlines have become increasingly responsive to ergonomic issues, said Herbert R. Meyer, senior technical officer at the International Federation of Air Line Pilots' Associations (IFALPA).<sup>15</sup>

IFALPA adopted a policy in 1996 recommending that all flight-deck seats be designed "to support the body of the pilot in all ergonomically desirable ways."

"Seats should be designed so as to permit full freedom of movement, in order for the pilot to perform the duties and functions in a satisfactory manner," the policy said. "Seat materials should be designed to ensure the pilot's health and comfort, to reduce fatigue and to minimize vibration transmission."

Besides the 1968 incident of back pain experienced by the New York Airways helicopter pilots, a 1994 study of flight-deck seating for Qantas Airways flight crews cited pilots' complaints of discomfort and lower back pain during middle-range flights and long-range flights but did not identify the cause of the discomfort.<sup>16</sup>

The study compared the areas of pain and discomfort identified by the Qantas pilots and said that the problem was a result of the failure of flight-deck seats to meet the biomechanical requirements of the lower back.

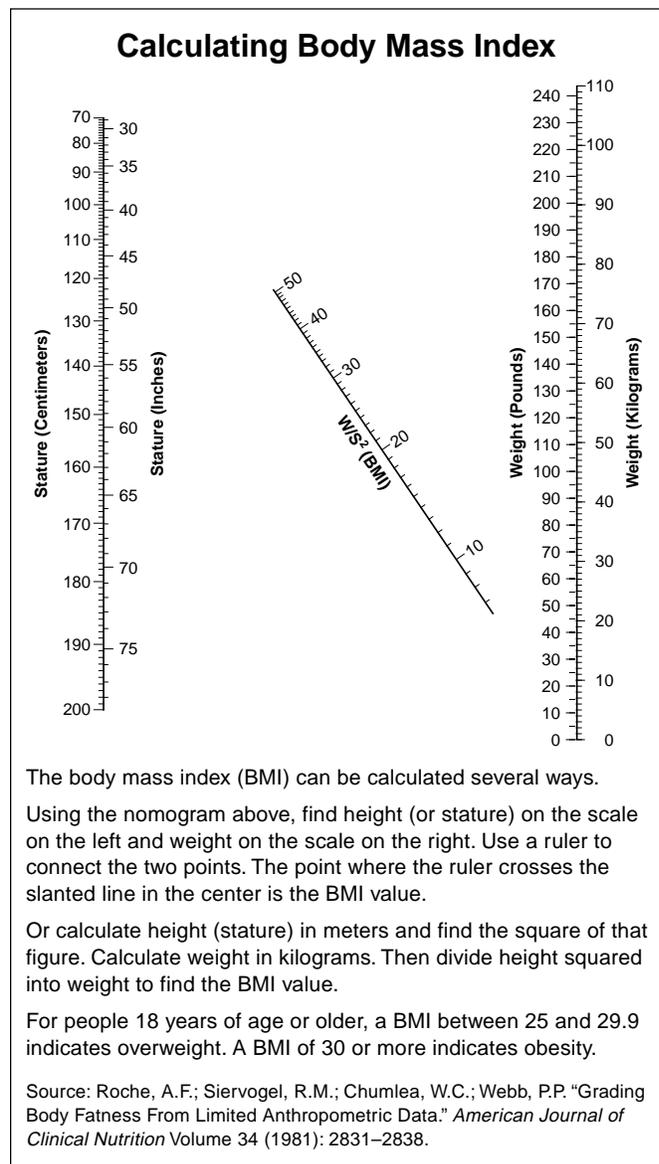
Proper ergonomic design is not, in itself, the answer to all pilot back problems, said Curt Graeber, Boeing's chief engineer for human factors.<sup>17</sup>

"There are a lot of variables in how people sit on flight decks," Graeber said.

An individual pilot's posture — and whether he or she uses the equipment in the manner intended to receive the benefits of its ergonomic design — is one of those variables, Graeber said.

Other factors that can contribute to lower back pain include:

- Lack of physical conditioning — Poor muscle tone; weak ligaments and tendons; and a lack of joint, limb and back flexibility increase the chances of back injury and of the development of chronic discomfort;
- Obesity — Excessive abdominal fat tends to place chronic forces on the lower back. Ideally, an individual's weight and body mass index (a formula that calculates the relationship between a person's height and weight) should be within the range recommended by standard health charts (Figure 2);
- Poor nutrition — Insufficient minerals in the diet can result in loss of calcium from the bones and can lead to skeletal injuries;
- Chronic cough — Chronic implosive coughing, which sometimes also characterizes smokers, places repeated



**Figure 2**

sharp stresses on the lower spine that can magnify other stresses and lead to back disease;

- Alcohol abuse — Ethyl alcohol has adverse toxic effects on muscle and nerve tissues. Decreased coordination, coupled with the toxic effects on body tissues, can lead to overstressed back muscles. Alcohol also is associated with falls, which can lead to back injuries, and with impaired reasoning, which can lead to unwise decisions to undertake physically stressful lifting;
- Variations in leg length — If an individual has significant asymmetry between the left leg and right leg, a pelvic side tilt can result, leading to lower back pain. Use of a simple, properly sized heel wedge or foot wedge inside the shoe on the foot of the shorter leg often can alleviate back discomfort;
- Osteoarthritis — Repeated injury to cartilage, the material that lines bone joint surfaces, gradually fragments the cartilage and results in osteoarthritis, which causes pain when joints are moved. Osteoarthritis can be prevented by warm-up and flexibility exercises, which spread lubricating fluid across the joint cartilage surfaces, minimizing the friction of movement and subsequent injury.
- Rheumatoid spondylitis and ankylosing spondylitis — An inflammation of the joints between the vertebrae or between the spine and the pelvis, most often inherited, eventually causes the affected vertebrae to fuse. Proper treatment helps prevent progression of the disease;
- Degenerated vertebral disk — A shock-absorbing material between the disks helps spread the load that is placed on the spine and helps absorb biomechanical shocks. The disks contain living cells, and daily activities pump nutrients into the disks and waste materials out of them. Inadequate exercise is unhealthy for the disk material and may promote degenerative changes in disks, including arthritic changes in the spine. Excessive bending or contortion can cause dislocation of a disk, producing pain and possibly resulting in the need for surgery or other treatment. Because the disk material and other spinal components are not subject to compression while a person is sleeping, an individual's height generally is 0.75 inch (1.9 centimeters) more in the morning than at night. Daily activities tend to compress the upright spine, slowly decreasing an individual's height; and,
- Osteoporosis — Poor nutrition, lack of exercise, a deficiency of calcium and certain hormonal factors may lead to a weakening of bone density known as osteoporosis. Pursuing an active, healthy lifestyle and obtaining a bone-density screening if back pain develops

may determine if osteoporosis is present and whether countermeasures are required.

Lower back pain is a common complaint, during some stage of their adult lives, for most people, including pilots. Nevertheless, precautionary practices can help flight crewmembers and others prevent pain or reduce its intensity or its frequency.♦

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### ***About the Author***

*Stanley R. Mohler, M.D., is a professor, vice chairman and director of aerospace medicine at Wright State University School of Medicine in Dayton, Ohio, U.S.*

*Mohler, who holds an airline transport pilot certificate and a flight instructor certificate, was director of the U.S. Federal Aviation Agency's Civil Aviation Medicine Research Institute (now the U.S. Federal Aviation Administration's Civil Aeromedical Institute) for five years and chief of the Aeromedical Applications Division in Washington, D.C., U.S., for 13 years.*

*Mohler received the 1998 Flight Safety Foundation Cecil A. Brownlow Publication Award for journalism that enhances aviation safety awareness.*

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