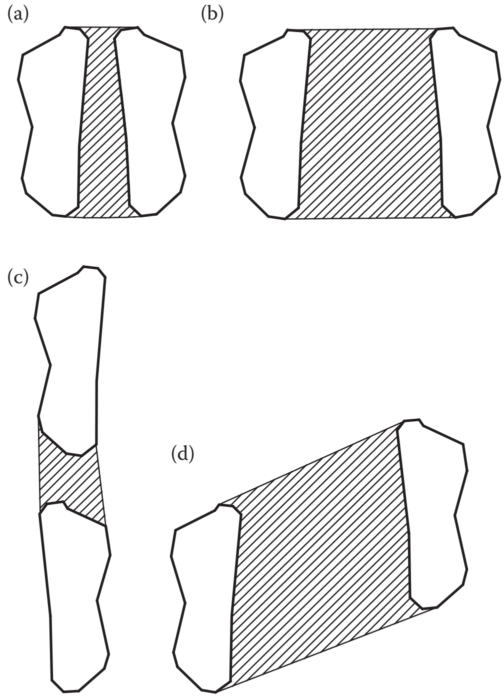

FIGURE 2.1 Stability of the body parts depends on the shape of the base of support described by the position of the feet: (a) unstable, (b) fairly stable in all directions, (c) stable anteroposteriorly, and (d) laterally stable.

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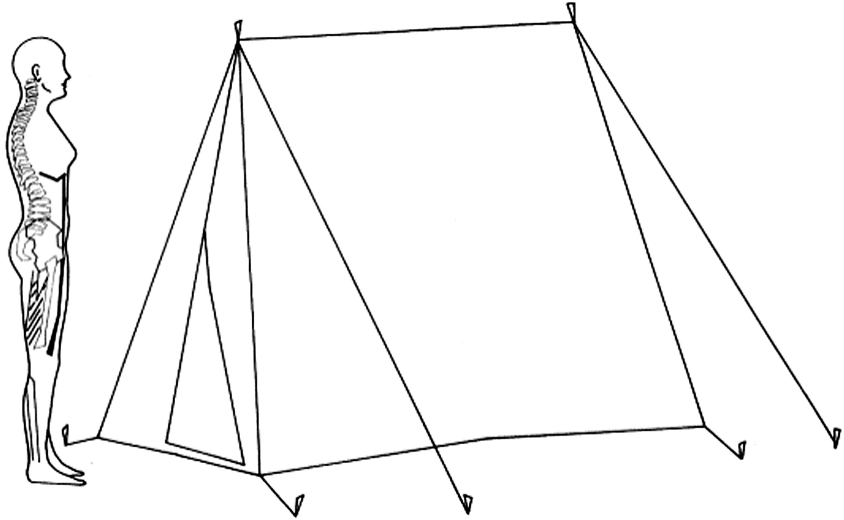

FIGURE 2.2 Tent analogy. The skeleton is the tent pole, the muscles are the guy ropes, and the soft tissues are the canvas.

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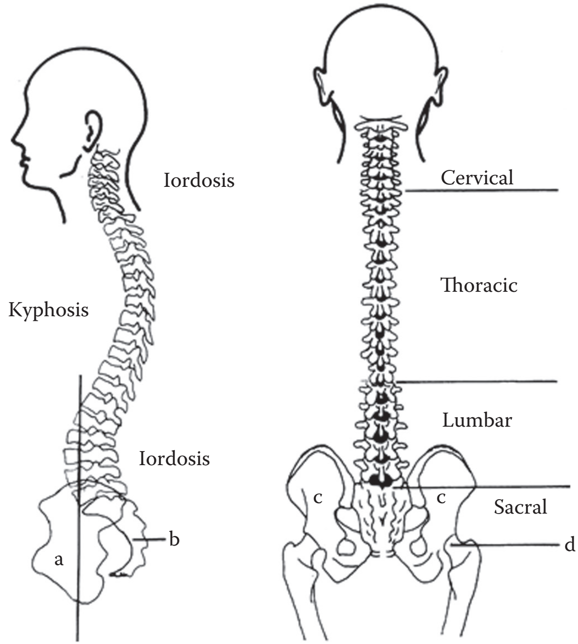

FIGURE 2.3 The lumbar, thoracic, and cervical spines and the pelvis (a) and sacrum (b). The weight of the upper body is transmitted through the lumbar spine, the iliac bones of the pelvis (c) to the hip joints (d) and legs.

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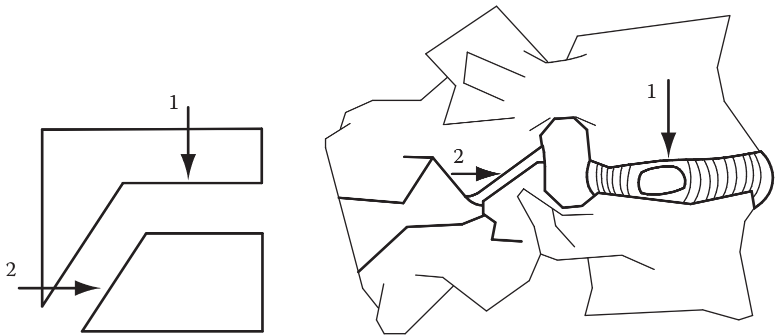

FIGURE 2.4 Function of (1) intervertebral disk and (2) facet joints. The disk resists the compressive load and the facets resist the intervertebral shear force. (From Kapandji, I.A. 1982. *The Physiology of the Joints*. Vols. 1–3. Churchill Livingstone, Longman Group, Edinburgh, UK. With permission.)

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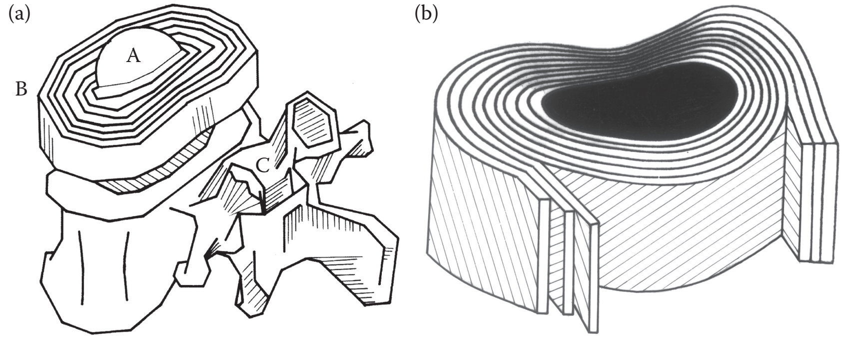

FIGURE 2.5 Intervertebral disk and vertebral body. (a) In this view, the superior vertebral body has been removed to reveal the intervertebral disk below. A is the nucleus pulposus, B is the annulus fibrosus, and C is the inferior facet joints at the rear. (From Kapandji, I.A. 1982. *The Physiology of the Joints*. Vols. 1–3. Churchill Livingstone, Longman Group, Edinburgh, UK. With permission.) (b) Details of the structure of the annulus fibrosus. The annulus consists of a number of layers of cartilage. The fibers in the layers run obliquely and in different directions, somewhat like the layers of a cross-ply tire. The outer layers run perpendicular to each other. (From Vernon-Roberts, B. 1989. *The Lumbar Spine and Back Pain, III*, M.I.V. Jayson, ed. Churchill Livingstone, Oxford, Edinburgh, UK. With permission.)

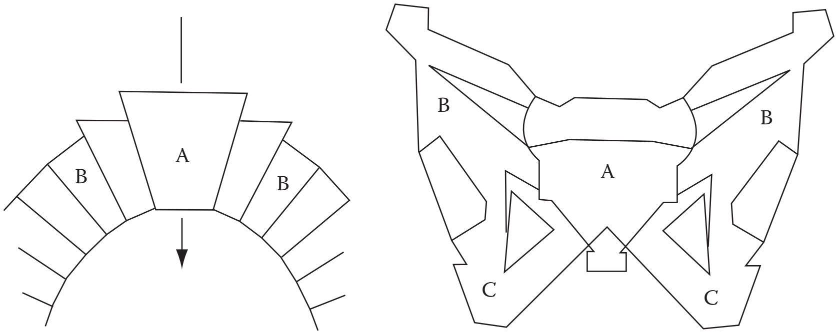

FIGURE 2.6 The pelvis as an arch. The pelvis viewed from the rear. A is the sacrum, B is the ilium, and C is the ischium. The sacrum acts like a true keystone in this plane. (Redrawn from Tile, M. 1984. *Fractures of the Pelvis and Acetabulum*. Williams & Wilkins, Baltimore, MD, London. With permission.)

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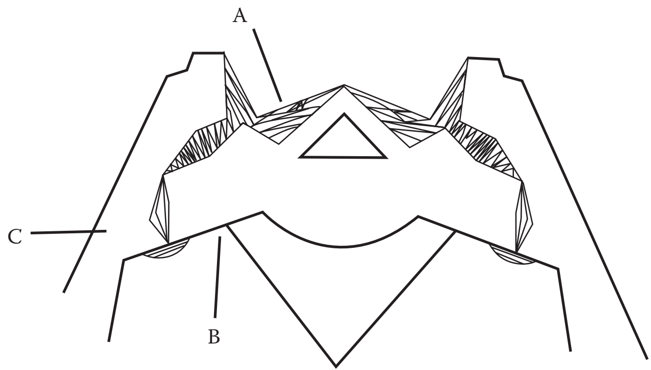

FIGURE 2.7 View of the sacroiliac joint from above. A represents the ligaments, B is the sacrum, and C is the pelvis. The ligaments act like the cables of a suspension bridge preventing the sacrum from slipping forward. If the joint is deformed by loading, the ligaments can be pinched by bone causing pain in the very low back usually on one side. (Redrawn from Tile, M. 1984. *Fractures of the Pelvis and Acetabulum*. Williams & Wilkins, Baltimore, MD, London. With permission.)

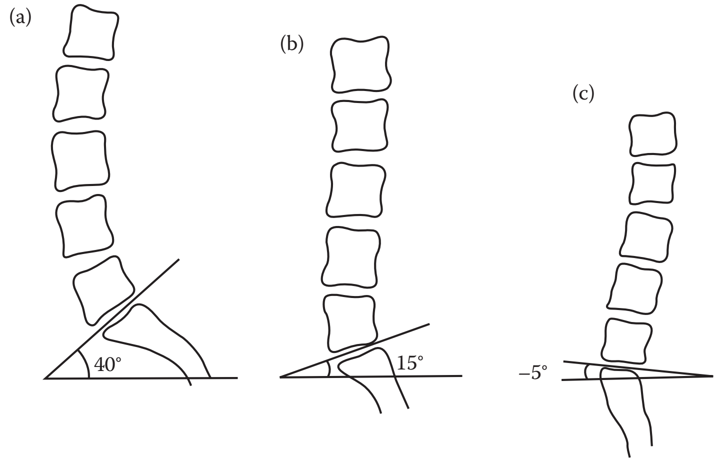

FIGURE 2.8 Relationship between sacral and lumbar angles. (a) Sacral angle and lumbar lordosis, as in standing, (b) Moderate sacral angle and fattened lordosis as in sitting on a chair with a backrest, and (c) Minimal sacral angle and tendency to lumbar kyphosis as in sitting on a low stool.

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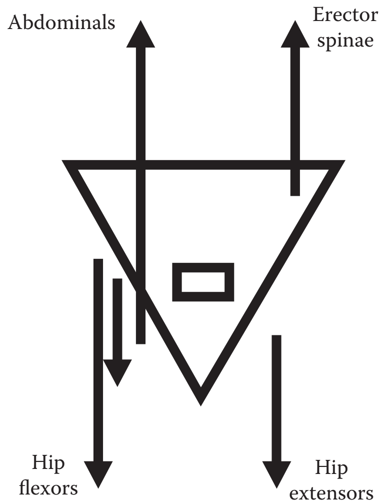

FIGURE 2.9 Schematic representation of the muscular system of the pelvis (sagittal view). When the abdominal or hip extensor muscles shorten, the pelvis tilts backward. The result is a flattening of the lumbar spine to maintain the trunk erect. When the hip flexors or erector spinae muscles shorten, the pelvis tilts forward. This is accompanied by a compensatory increase in the lumbar lordosis.

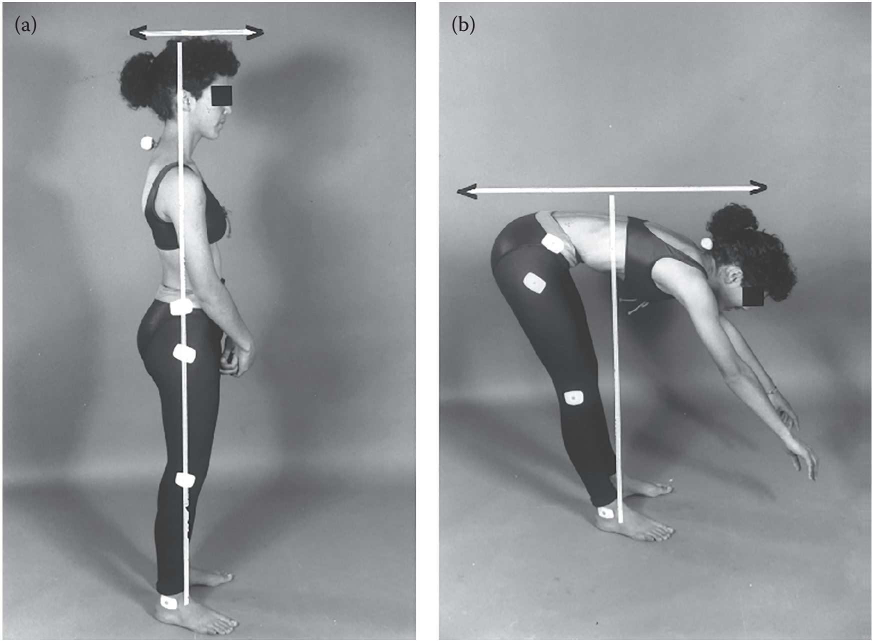

FIGURE 2.10 When the base of support is constrained, compensatory movements occur automatically to maintain postural stability demonstrating that the "attitudinal as well as the righting reactions" are indeed involuntary. (a) Balanced erect standing posture and (b) as the hip joints flex and the upper body moves forward, the ankle joints plantar flex to compensate and the lower body moves rearward, maintaining balance.

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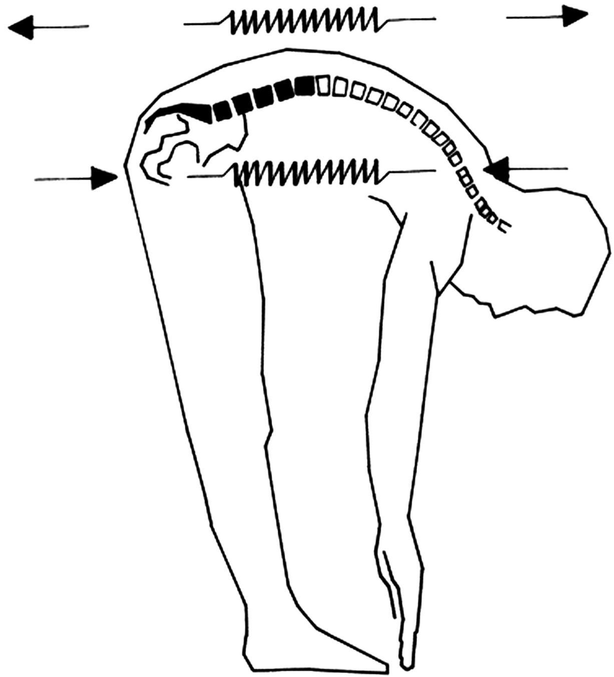

FIGURE 2.11 In this position, postural stress occurs in the form of compression of abdominal contents and intervertebral disks and stretching of the posterior spinal ligaments.

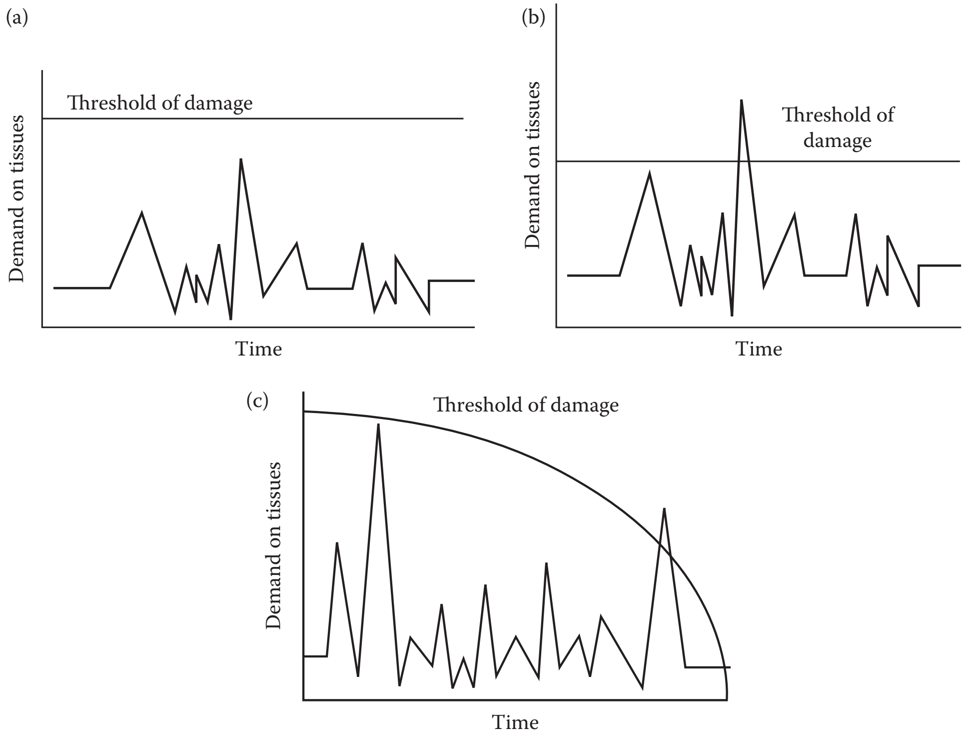

FIGURE 2.12 The specification of force limits for safety (a and b) is complicated by factors such as fatigue that can lower the threshold for injury of the tissues (c). (From Professor S. McGill, University of Waterloo, Canada. With permission.)

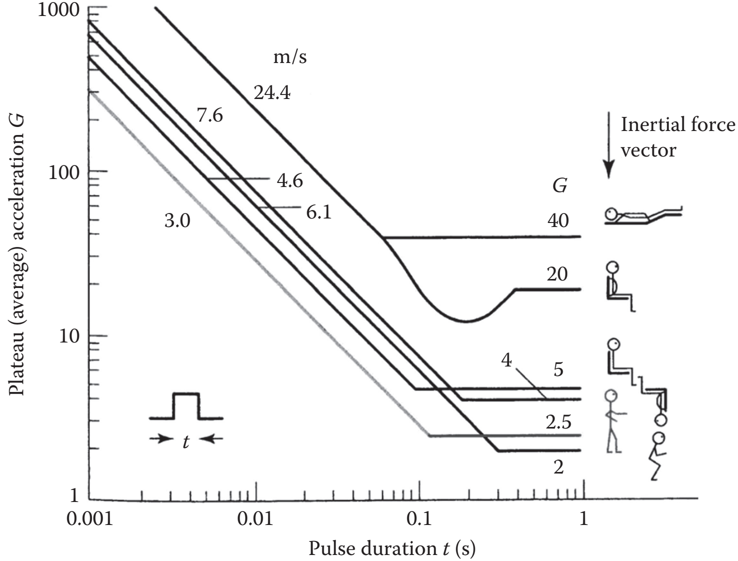

FIGURE 2.13 The tolerance to human whole-body impact for critical velocity change, critical acceleration level, and critical duration. (From Glaister, D.H. 1978. *Injury*, 9: 191–198. With permission.)

FIGURE 2.14 Darren Taylor, also known as Professor Splash, dives from 8 m high into a 30-cm shallow pool of tomato sauce during a promotion at Darling Harbor in Sydney, Australia. Note the "belly flop" technique. (Courtesy of Darren Taylor.)

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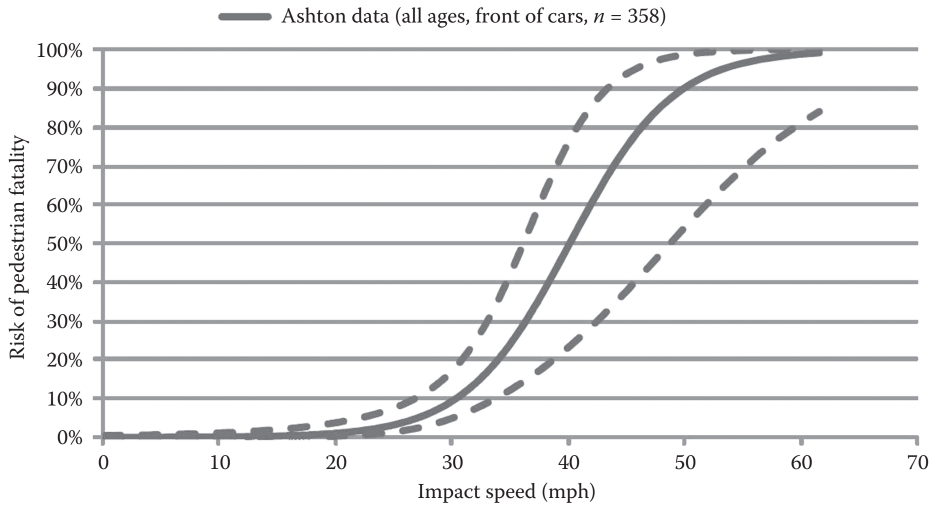

FIGURE 2.15 Risk of pedestrian fatality at different automobile impact speeds.

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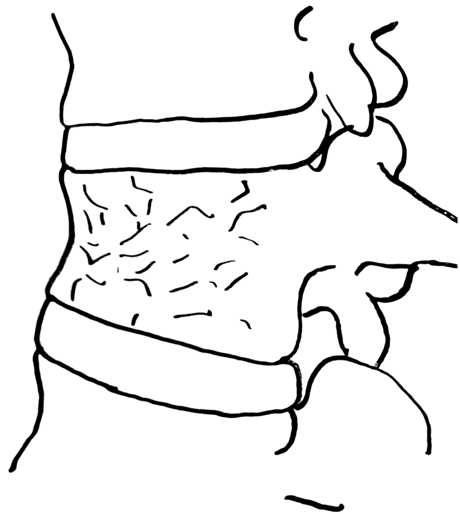

FIGURE 2.16 Wedge fracture at T12–S1.

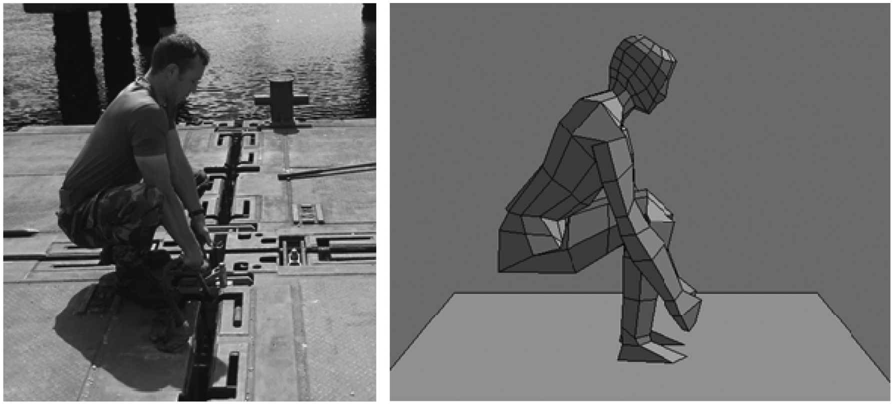

FIGURE 2.17 Sample output of SSPP (University of Michigan). Lifting a mooring bollard weighing 38.6 kg. Joint angles, measured from the photograph, were entered into the SSPP together with the mass of the operator. 3D SSPP analysis revealed an estimated 6880 ± 503 N in the lower back during this one-person lift. This is in excess of the recommended limit. The hip joints were the limiting joints in this posture and lift, with sufficient strength capability estimated in 58% of people, that is, 58% of males have sufficient hip strength to perform the lift.

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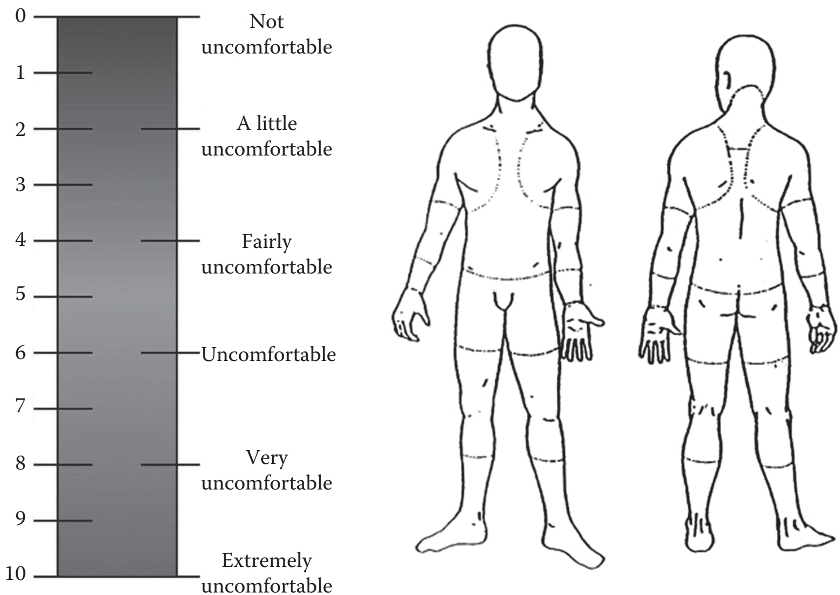

FIGURE 2.18 Body diagram for pain rating. These are often included in questionnaires for use in ergonomic surveys. Pain is often rated on a 10-point scale where 1 = mild discomfort and 10 = the pain could not be worse.

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