

SECTION

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Exercise Performance and Environmental Stress

“The true explorer does his work not for any hopes of reward or honor, but because the thing he has set for himself to do is a part of his being, and must be accomplished for the sake of the accomplishment. And he counts lightly hardships, risks, obstacles, if only they do not bar him from his goal.”

Admiral Robert E. Peary, Polar Explorer

Sport activities often take place at terrestrial elevations that impair oxygenation of blood flowing through the lungs and severely limit aerobic energy metabolism for exercise. At the other extreme, exploration beneath the water’s surface poses a different challenge. Divers must transport their sea-level environment as a gas mixture compressed in a scuba tank carried on the back. Some diving enthusiasts use no external assistance, and the length of an underwater excursion becomes limited by two factors: (1) the quantity of air inhaled into the lungs just before the dive and (2) the buildup of arterial carbon dioxide during the dive. In both breath-hold diving and scuba diving, the environment provides unique challenges and dangers for the participant, often independent of the stress of exercise. Consideration also must focus on the thermal quality of the environment. On land, exercising in a hot, humid environment or extreme cold imposes severe stress. These environmental demands impair exercise capacity and pose a severe threat to health and safety.

Space exploration and accompanying short- and long-term exposures to near-zero gravity present a unique set of environmental stressors that impinge on physiologic function, structural mass, and exercise capacity both during flight and upon return to Earth.

The extent that each environmental stressor deviates from neutral conditions and the duration of the exposure determine the total impact on the body. In addition, the effect of several simultaneous environmental stressors (e.g., extreme cold exposure at high altitude) may exceed the simple additive consequence of each stressor imposed separately.

In the four chapters that follow, we explore the specific problems encountered at altitude, during exercise in hot and cold environments, and prolonged exposure to microgravity. We also discuss the immediate physiologic adjustments and long-term adaptations as the body strives to maintain internal consistency despite an environmental challenge. The chapter on sport diving considers the unique problems associated with this increasingly popular form of sport and recreation.