PAUL R. MEYER, JR., MD, MM, COL. USAR is a 1954 graduate of Virginia Military Institute, a 1958 graduate of Tulane Medical School, and he completed his other residency training at Charity Hospital, New Orleans, LA, in 1963. Upon completion of this training Dr. Meyer entered active duty, U.S. Army, where he remained until August 1965. Dr. Meyer immediately joined the Orthopaedic Surgical Faculty at Tulane Medical School, remaining there until his departure for Viet Nam in March 1967. Dr. Meyer returned in September 1967 to join the faculty at Northwestern University, where he has remained for the past 27 years. Since joining the faculty, Dr. Meyer has ascended through all of the academic ranks to the rank of Full Professor of Orthopaedic Surgery (1977 to present).

Dr. Meyer is a founding father in the development of trauma centers in the United States. He founded the first (and still largest, U.S.) Acute Spine Trauma Center in Chicago. The latter activity, since its founding in 1972, has been under the sponsorship of the National Institute on Disability Rehabilitation Research.

Dr. Meyer has extensive experience; he is internationally acclaimed in the area of surgery of spine trauma and in the development of spine trauma centers. He is the author of a surgical text book on spine trauma and of more than 50 scientific papers, and has served as a technical advisor in spine trauma centers and surgery to governments around the world. His latest participation was in behalf of the Government of the United Arab Emirates (Nov., 1993).

Dr. Meyer continues to serve in the active United States Army Reserve, at the rank of full Colonel. Besides his presence in Viet Nam in 1967, he has served in El Salvador as liaison between the U.S. Army Surgeon General's Office and the Chief of Staff of the El Salvadorian Army (1985); as a Paratrooper, in Africa with a special forces unit (Kenya 1989); and was activated and served as company Chief of Orthopaedic Surgery in the U.S. Army Hospital in Landstuhl, Germany during Desert Storm. Dr. (Col.) Meyer serves as Reserve Orthopaedic Consultant to both the U.S. Army Surgeon General and the U.S. Army Aeromedical Center, Ft. Rucker, Alabama. He is a member of the Spinal Cord Injury panel of the Department of Veterans Affairs, Rehabilitation Research and Development Service Scientific Merit Review Board and the recipient of numerous civilian and military awards.

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GUEST EDITORIALS

Health Benefits Derived by a Person with Paraplegia who is Involved in Sports
or
Why Sports are Important in the Life of the Person with Paraplegia
by Paul R. Meyer, Jr., MD, MM

Much has been written about the alterations in organ system physiological function associated with spinal cord neurological trauma. While these alterations are of immediate concern, there are concurrently present and of equal importance, unseen, scientifically immeasurable and often unrecognized, devastating psychological changes that have the power to influence and negatively affect every organ system's physiological recovery. Accepting this supposition assists in crystallizing the psychological importance of sports in the life of a spinal cord injured person.

To note a few of the metabolic changes one might anticipate with the onset of neurological injury and paraplegia, they include: *alterations in cardiorespiratory system output, decrease in oxygen transport capacity, an altered vasomotor regulation system with poor venous return, a reduction in muscular strength and endurance, a decreased ability to maintain good physiological and psychological adaptation, pooling of blood in paralyzed regions, a reduction of cardiac preloading and performance, extensive muscular and vascular deficiency, a reduced blood volume, and a relatively small heart volume.* Because these disabilities are the result of nervous system injury, it becomes readily apparent that some mechanism should be found to ameliorate or alter these deleterious physiological factors.

During the International Year for Persons with Disability (1981), much attention was placed on the importance of fitness in the lower limb disabled wheelchair-confined individual. In the process, muscle strength and endurance received much less attention than did the cardiorespiratory systems, in spite of their importance in the performance of activities of daily living. Also neglected were the effects of psychological correlates upon the whole conditioning process. Recognizing that fitness in the disabled is poor, and that the everyday propulsion of a wheelchair is not an effective means of providing or maintaining cardiorespiratory conditioning, other mechanisms have been sought. Research in this area has demonstrated that forearm pedaling and arm cranking exercises, along with upper limb weights are each effective cardiac output enhancers. It would appear that the effectiveness of these activities is through an alteration in the oxygen transport capacity to active muscles due to changes in vasomotor regulation below the level of the lesion (1).

In the same vein, due to the presence of limited physical activity in the individual with disabilities, there results a pooling of blood in the paralyzed lower limbs. This effects a reduction in "cardiac preloading" (2). "In trained paraplegics, as well as competitive paraplegic athletes, both displayed to the same extent...a conspicuously poorer cardiovascular capacity in relation to able-bodied individuals." The reason: a poor venous return, a reduced blood volume, and a smaller heart volume secondary to extensive muscular and vascular deficiencies. It is well-recognized that individuals with spinal cord paralytic lesions have a greatly reduced activity level, often producing additional associated medical complications. This combination results in a patient's involuntary "isolation" (3). Together, these result in a higher incidence of cardiovascular disease than seen in the general

A wheelchair racer in action.

population. In a group of adults with lower limb disability, by means of increasing the exercise load, the frequency of training, the load range and ergometric stimulus 'density,' there has been noted a real increase in stamina, strength, and coordinated abilities (4), which suggests that gains in performance might follow active arm crank exercising (2).

Confirming the above is a study that sought to predict leisure time exercise behavior among a similar group of persons with lower limb disabilities. The variables observed and measured included: habit, education, disability type, fitness level, and an "exercise follow-up." The most important variable found was intention. Two important factors requiring consideration are: the cause of the individual's disability and the strength of the individual's exercise habit. Both greatly influence exercise behavior (5).

It is well-recognized that individuals with spinal cord lesions frequently have present several "active" variables. They include: a greatly reduced activity level, multiple additional medical complications, involuntary "isolation," and a high incidence of cardiovascular disease. Also present is the fact that normal daily activities for a person with paraplegia or quadriplegia are insufficient to maintain "a satisfactory level of physical fitness" (3).

Individuals with paraplegia are at great risk for the development of heart disease because of "low-HDL-cholesterol." Exercise has been identified as an important means of "elevating HDL cholesterol." Thus, "long-term coronary risk factors have been greatly reduced following a marked increase in the HDL cholesterol level" (6). Therefore, a long-term method of managing this disability is the incorporation of strenuous exercise (such as swimming) into the lifestyle of the person with paraplegia. There is also good evidence that exercise training is very effective in decreasing the resorptive process of the skeleton by decreasing bone and collagen catabolism, aiding in new bone formation (7).

A finding in sports medicine is that "continuous training must take place with relatively high intensity" in order to produce an effective circulatory response. To accomplish this, "stamina training" of skeletal muscles must ensure that the capacity reserves of skeletal muscle are developed (4).

All of the aforementioned activities seem to indicate that active participation in "sports" serves as an effective means of achieving and maintaining good physiological and psychological adaptation to neurological injury resulting in wheelchair living (8). An additional aim of rehabilitation (and sports participation) is to increase the active participation in daily life activities of persons with physical disabilities.

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