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Considering Safe Water Entry

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Considering Safe Water Entry

The lead article in this issue by Andrew Cornett and colleagues is the first study of racing starts conducted during actual swimming competition (Cornett, White, Wright, Willmott, & Stager, 2010). This research group from Indiana University has studied a number of biomechanical variables related to head first dives performed into approximately 3 feet water depth, the minimum depth allowed by USA Swimming. They addressed the important question of how much risk may be involved when diving into shallow depth water. In this essay, I explore the broader question of safe water entry that is not limiting the discussion to racing starts, but to all kinds of water entry.

Between 200,000 and 300,000 living Americans currently suffer from spinal cord injuries (SCI) with an estimated 12,000 new cases occurring each year (National Spinal Cord Injury Statistical Center, 2010). About 1,000 (8%) of those annual injuries are estimated to result from participation in sports and recreational activities (NSCISC, 2010). DeMers (1994) had estimated that about 700 annual recreational diving injuries occurred, but that estimate seems somewhat high when compared to the most recent NSCISC data. Regardless of the actual numbers or percentages, it is easy to acknowledge the seriousness of diving-related spinal cord injuries, both in human suffering, rehabilitation costs and resources, and lost productivity. SCIs are second only to drowning in their seriousness and riskiness within the field of aquatics

Water Entry

Safely entering the water should be considered to be one of the foundational aquatic skills that all swimmers ought to master as part of the learn-to-swim process (American Red Cross, 2009; Langendorfer, 2010). The risk of spinal cord injury obviously is magnified because of the gravitational acceleration associated especially with head first entries, also known as dives. When the depth of the water to be entered is shallow, unknown, or likely to contain any kind of obstruction, safe entry always involves going into the water feet first (Langendorfer, 2010).

Langendorfer and Bruya (1995) described the development of water entry as a five-step developmental sequence in their Aquatic Readiness Assessment Instrument. Over the process of learning to swim as a result of instruction or experience, individuals appear to change from not being willing to enter the water voluntarily to entering feet first and then to entering head first. It is interesting to note that at less advanced levels of development, persons tend to employ a less risky head first mode of getting into the water. Individuals only seem able to plunge into the water head first after they have acquired a more advanced level of water skills and a certain degree of balance that allows the body to become inverted in the air and water.

Head First Entries

I recall sometime in the 1980s at a CNCA conference when I first heard Royce VanEvera from the New York State Health Department describe the data they had collected regarding the incidence of SCIs related to head first entries (personal communication). Two particular facts stuck with me all those years. First was that the only SCIs they documented had occurred in water 5 feet or less in depth. The other was the high incidence of SCIs that occurred at outdoor sand beaches, both surf and non-surf, as a result of persons performing a run and plunge into the water whereupon they struck their heads in the gradual beach incline causing a disastrous hyperflexion of the neck.

Even at that time, I realized that the five foot critical depth for SCIs was most likely an artifact resulting from the fact that in most swimming pools there is very little, if any, water that is actually between 5 and 8 feet in depth. Typical public pools are built with a shallow end, with water that is typically 3-5 feet deep, and a deep end that is 8 feet or deeper. The transition from shallow to deep ends is usually not gradual, but fairly steep with minimal surface area. This provides little area of water depth between 5 and 8 feet. This means that head first diving usually occurs either in water less than 5 feet deep or greater than 8 feet deep.

Different Types of Diving

When considering the question of what is a “safe diving depth,” it seems to me that one needs to consider the multiple types and purposes of head first diving. The Cornett et al. (2010) study focused on *racing starts*, particularly those during actual competition. Racing starts essentially are long, shallow head first plunges that typically occur from a racing block that is situated 1 meter above the water surface.

The American Red Cross (2009), in considering and recommending a safe diving depth, has been primarily concerned with vertical head first dives, both from the side of a pool/dock or from a diving springboard. For the time being, they have recommended a water depth of no less than 9 feet for a standard vertical dive from a pool side and no less than 11 feet when diving from a standard 1 meter springboard. They also have considered whether learning to dive may require more *or* less water depth than the act of diving performed by someone who already knows how to dive. Paradoxically, a beginning diver who does not understand how to streamline the body, reducing form drag upon entry, may actually be relatively safer in somewhat shallower water than 9 feet.

At the moment, aside from the few studies that have examined the depth of racing dives as reviewed by Cornett et al. (2010), there is very little research evidence to support what water depths may be safe for non-racing start dives. Because of the severity of SCIs that could result from diving into water that is too shallow, the aquatic field certainly has the need to investigate this issue and to begin making decisions using an evidence-based approach. Until we understand all the implications, it is probably important to maintain the current Red Cross recommendations of using at least 9 feet of water depth for vertical dives, even for beginners.

Water Entry Risk Constraints Model

Because there is still so much we need to know and understand both about the water entry acquisition process as well as the task and environmental factors that alter the degree of risk associated with entering the water, I am suggesting that it might be helpful to have a model by which to understand how various factors and variables may interact in ways that increase or decrease risk of SCI. I propose that a model adapted from Newell's constraints model (1986) provides just such a way of viewing variables that need to be considered in understanding characteristics of water entry (see Figure 1).

The proposed model works by helping focus attention on the fact that the safety and risks associated with water entry depend upon the interactions among the characteristics of individual swimmers (e.g., body size, body proportions, experience), the water entry task factors (e.g., head vs. foot entry, goal of entry, angle of entry), and the environmental factors (e.g., water depth, entry height). The implications of this model are that a person with greater body mass who is doing a deep plunge dive from a 1 meter springboard probably requires a greater water depth than a much smaller individual who is doing a racing start from a starting block. The model argues for a much more flexible approach to viewing water depth than we currently take. For example, we mainly consider water depth, not the size and skill of the individual, and the goal of the specific type of entry.

Figure 1 — Safety and risk factor constraints model for studying water entry.

Of course, it is all well and good to argue for an individualized approach that this constraints model suggests. The model certainly provides guidance into investigating to determine what factors (e.g., body mass vs. water depth vs. angle of entry) most significantly contribute to increasing or decreasing risk. The challenge is how to adapt this model and the information that it could provide into practical policy and regulations. Should an organization such as USA Swimming or the Red Cross use a “worse case scenario” approach, thus taking as conservative an approach as possible? Or, are there acceptable ways to individualize diving regulations similar to the minimum height regulations often used at amusement parks to restrict entry into the most risky thrill rides?

As a “developmentalist,” I find such complex questions to be intriguing and challenging all at the same time. The easiest approach always has been to key on a single dimension such as age or water depth. Realistically, I believe the risk constraints model will give us the information to know whether it is satisfactory to use a single variable or whether research will argue for paying attention to several key variables such as body mass, water depth, type of entry, and angle of entry. I urge readers to pay attention to future issues of *IJARE* in which I am sure authors will be exploring some of these issues about what constitutes a safe diving depth.

Steve Langendorfer, Editor
International Journal of Aquatic Research and Education

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