PROCESS FOR EFFECTIVELY STUDYING THE BIOMECHANICS OF INJURY IN YOUTH SPORTS

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The mechanisms of injury are the processes by which injuries occur in sport. These processes involve complex interactions among many factors associated with the performer (internal factors) and the sport environment (). This paper addresses various concerns that should be evaluated when attempting to develop an understanding of the biomechanics of injury in youth sport activities.

An injury mechanism model, that had been previously developed (Brown, 1987), has been modified to include additional concepts related to the study of the biomechanics of injury in youth sports (see Figure 1). Additional elements in this revised model include (a) a questionnaire to collect retrospective data on the athlete (performer) and the sport environment; (b) research on injury mechanisms to understand the injury process; and (c) recommendations to prevent injuries and reduce their severity.

Each athlete comes to the sport setting with his/her own set of physical, psychological, and cognitive characteristics. These characteristics are internal to the performer and are the result of past experiences and development. Therefore, they change over time. Examples of these characteristics are as follows: (a) physical characteristics – strength, somatotype, weight, gender, skeletal maturation; (b) psychological characteristics – trait anxiety, self-confidence, risk taking, state anxiety; and (c) cognitive characteristics – knowledge of rules, knowledge of safe performance, knowledge about the opponent, knowledge about how to use training equipment, strategy. Each specific characteristic may have an influence on an athlete's potential for injury. In studying injuries associated with youth involvement in sport, it is important to consider specific personal characteristics. Even though there are many specific characteristics associated with each athlete, coaches and biomechanists may have insight into the physical, psychological, and cognitive characteristics of athletes and thus to be able to identify a few key characteristics to study as logically important contributors to injury.

Each sport setting, whether for training or actual sport competition, contains many environmental factors that can be contributors to injury. However, they can also change with time. These environmental factors are external to the athlete. They include items such as condition of the field, characteristics of implements used in sport, properties of protective equipment, and forces and torques applied to the athlete. Similar to the specific characteristics of the performer, there are many specific characteristics associated with each sport environment. Insight into which of these are important factors in contributing to injury in sport requires the insight of coaches and biomechanists to selectively identify specific environmental factors to study.

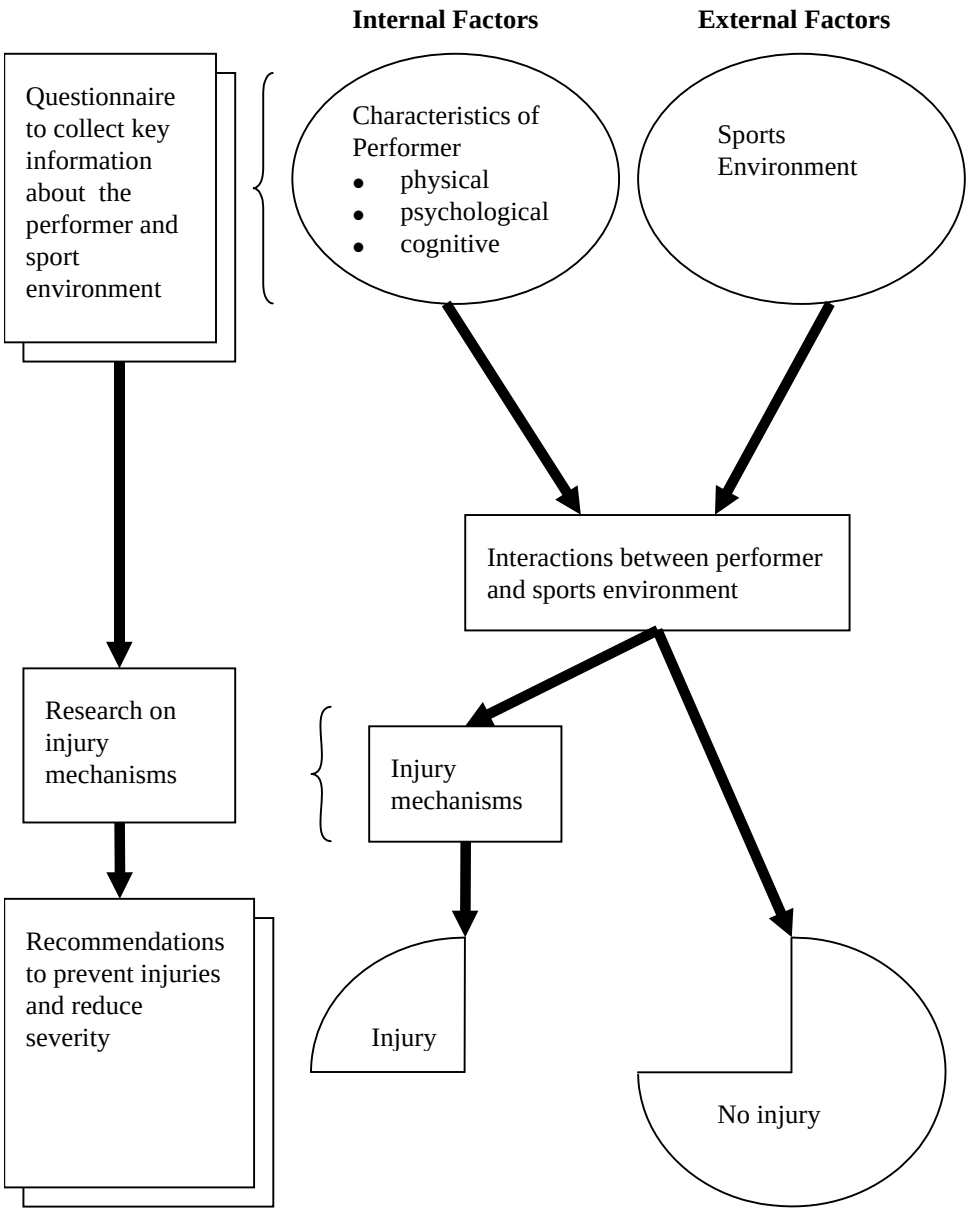

Figure 1. Schematic model for the study of injury mechanisms in sport.

METHODS: The schematic model presented in Figure 1 suggests that injuries in sport result from interactions, on an individual level, between the athlete and the sport environment. The suggested relationship between performer and

environment is in accord with Lysens et al. (1984), who stated that “sports injuries result from a complex interaction of identifiable risk factors at a given point in time.”
A two stage process was developed to study the biomechanics of injury in young athletes. The first stage involved the development of a questionnaire to collect retrospective information about the performer, sport environment, and interaction between the performer and sport environment. In general, questionnaire items address the physical characteristics of young athletes, history of their sport participation, level and incidence of pain associated with their training and participation in sport, conditions under which their sport was conducted, and sites and types of injuries sustained. Questionnaire items must be specifically developed for each sport and rely upon the insight of knowledgeable coaches and sport biomechanists. A questionnaire was initially developed to specifically address injury mechanisms in teenage powerlifting (Brown & Kimball, 1983; Brown & Abani, 1985). This questionnaire has been modified to make it compatible with the specific terminology and sport involvement characteristics of other youth sport groups and its utility has been tested on these groups (Brown & Mckeag, 1987; Brown et al., 1996).
The second stage of this process involved drawing relationships between regions of the body with relatively high levels and incidences of pain (areas susceptible to overuse and acute injury), injury sites and types, and the kinetics of selected sport skills that were suspected of precipitating these problems. In powerlifting, for example, from the questionnaire administered to teenage subjects, it was learned that they experienced a relatively high level and incidence of pain in the lower back region and that fifty percent of their reported injuries occurred in this region (Brown & Kimball, 1983). Based on the questionnaire results, a kinetic model was developed to subsequently study the movement patterns in powerlifting (Brown & Abani, 1985) in order to more fully understand the injury mechanisms.

RESULTS: This process was successfully employed in collecting data on youth participants in powerlifting, pairs skating, gymnastics, and rowing. It has resulted in a strategy that can be used to collect similar information on other youth sport groups. It should be noted that this process is not as definitive in sports classified as “open” (sports in which the physical activities are somewhat unpredictable - e.g., soccer, American football, and basketball) in comparison to those that are classified as “closed” (e.g., shot put, weightlifting, and crew).

CONCLUSIONS: By studying the mechanisms of injury in youth sports, the incidence and severity of injuries can foreseeable be reduced through rational decisions and recommendations regarding the (a) modification of sports rules; (b) design and use of sports equipment and personal protective supplies, devices, and clothing; (c) equation of competition; and (d) establishment of age requirements.

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