THE NEED OF BIOMECHANICS RESEARCH IN YOUTH SPORTS

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"Youth sports" may be defined as school and agency-sponsored activities associated with the physical participation in sport by youth who range in age from 5 to 18 years.

YOUTH SPORTS DEVELOPMENT

In the United States, organized youth sports programs did not begin until after 1900. These initial programs were run by schools. Highly organized sports programs for youths, outside the jurisdiction of the school, were not evident in this country until the 1920's. These early programs were for boys (Barryman,1978). Since then, there has been a steady and rapid rise in the number of boys participating in organized youth sports. More recently, this growth has been paralleled by similar development in youth sports programs for girls.

The growth in the number of children and youth participating in organized sport, outside the jurisdiction of the schools in the United States, has been promoted by single-sport agencies and community recreation departments who sponsor and sanction competition and establish rules and rule modifications specific to youth participation. According to Seefeldt (1981), an unfriendly relationship existed in the 1950's and 1960's between public school personnel and single-sport agencies. Policy statements of the National Education Association and the American Medical Association expressed opposition to highly organized sports activities for youth below the ninth grade. However, youth sports programs continued to grow.

Beginning in the later part of the 1970's, educators, concerned with perceived youth sports problems, organized to discuss these issues at national meetings:

1. National Association for Sport and Physical Education (NASPE) Task Force meeting; June, 1976.

2. First National Youth Sports Conference; February, 1979; sponsored by NASPE Task Force.

3. National Youth Sports Forums; September, 1979 and April, 1981; sponsored by the Youth Sports Institute, State of Michigan.

4. Great Lakes Regional Youth Sports Forums; July, 1980, 1981, and 1982; sponsored by the National Recreation and Parks Association.

Generally, these meetings were directed at concerns for physical and psychological stress imposed on young athletes. Youth Sports Guide for Coaches and Parents (Thomas,1977) and Guidelines for Children's Sports (Martens and Seefeldt,1979) summarized conditions under which healthful sports competition for children and youth

should occur. During this same time frame, national educational programs for volunteer coaches of young athletes were formulated. These programs were summarized at a national symposium (Cox,1982) on educating youth sports coaches. This meeting was sponsored by the American Alliance for Health, Physical Education, Recreation and Dance.

BIOMECHANICS RESEARCH ON YOUTH SPORTS

In the past, a preponderance of biomechanics research on children and youth has been directed at a quantitative verification of qualitatively described motor development sequences and stages of performance of fundamental motor skills. Examples of this type of research can be found for running (Beck,1966; Brown,1978; Dittmer,1962; Fortney,1964), jumping (Roy, Youm & Roberts,1973), and throwing (Ekern,1969). Wickstrom (1977) summarized much of this literature.

Only a small proportion of biomechanics research in sport has been directed at the young athlete. Review of A Bibliography of Biomechanics Literature (Hay,1981) reveals this paucity of research on youth participants in sport. Biomechanics research on sport, found in this bibliography, was predominantly on adult athletes and/or top level performers. (It should be noted that, in sports such as women's gymnastics, swimming, figure skating, and tennis, top level performers may be in the youth sports age range.)

INHERENT PROBLEMS IN BIOMECHANICS RESEARCH IN YOUTH SPORTS

From research study to research application, the discipline of biomechanics has had difficulty making an impact on youth sports. These difficulties include:

1. Financial support - Very little financial support for biomechanics research on young athletes exists. Single-sport agencies, community recreation departments, and public and private schools are the groups that run youth sports programs. However, they are not in the business of conducting and financing research. Faculty and graduate students occasionally will receive university support for biomechanics research on young athletes.

2. Rapid morphological change in young athletes - The anatomical, physiological, and motor control systems of adult athletes, training for and participating in sport, change gradually. Whereas, the youth sport athlete is likely to be undergoing rapid structural and form changes. Therefore, biomechanics study of young athletes is complicated by the need to study them in various stages of maturation. Also, mass parameter data of the body segments of children and youth are not available for various stages of physical development. Therefore, some kinetic studies must rely upon mass segment data from adult cadavers, which may severely compromise the research.

3. Application of biomechanics research from adult athletes - As previously stated, most biomechanics studies of sport involve adult athletes. Athletes participating in youth sports are not miniature adults. Young athletes are developmentally different than adult atheltes; their muscle mass is considerably smaller, their extremities are proportionally shorter, and their motor control may not be fully developed. Therefore, these differences need to be accounted

for before attempting to apply results from biomechanics research on adult athletes to young athletes.

4. Translation of biomechanics research - Because of the technical nature of biomechanics research, most youth sports coaches, whether paid or volunteer, have an extremely difficult time translating biomechanics research into pragmatic application. Not only is the translation process difficult, but the time required to engage in this process is prohibitive to most coaches of young athletes. Youth sports coaches cannot be expected to keep abreast of research in a field which is removed from their profession. Research in many areas have pertinence to youth sports, but coaches will not generally be the ones to keep up to date with recent findings. Most youth sports coaches are primarily interested in "how to" coach and very rarely ask "Why?". Some attempts have been made to translate concepts from college and university texts in biomechanics and kinesiology (Brown,1983; Greenlee, Heitmann, Cothren & Hellweg, 1981; Tolbert,1982) so that the layperson could more fully comprehend. However, generic information, even though it is presented in a simplified form, usually is not what youth sport coaches are receptive to; they are interested in sport specific information. Therefore, in order for biomechanics concepts and research to influence youth sports, they must be translated and applied specifically to individual sports.

NEED FOR BIOMECHANICS RESEARCH IN YOUTH SPORTS

According to Martens (1978), there is an estimated 17 million children, between the ages of 6 and 16 years, participating in over 30 non-school sponsored sports programs each year. In another survey conducted by the Athletic Institute (Parker,1975), 20 million children were estimated to participate in non-school sports. Vogel and Seefeldt (Note 1,1981) have also reported that over 5 million children annually participate in a variety of school sponsored youth sports programs. Thus, a substantial proportion of the youth population of the United States participates in youth sports. This massive involvement of youth in sport, coupled with concerns for exposing young athletes to the potential physical stresses (Harvey,1982; Kozar & Lord,1983; Micheli,1983; Thornton,1974) associated with participation, substantiates the need for biomechanics research as well as other types of research.

There are three general areas in which biomechanics research is needed and can have an important impact on young athletes participating in sport.

Injury Mechanisms

The Consumer Product Safety Commission (1984) is a United States government regulatory agency which functions to reduce the risk of injury to consumers. One way in which it attempts to accomplish this function is through its National Electronic Injury Surveillance System (NEISS). Through a sampling of injuries seen in hospital emergency rooms, NEISS is able to project a national incidence of injuries associated with the use of consumer products. This data collection process also includes sport injuries, in the 5 to 14 and 15 to 24 year age groups, associated with "activity, equipment and apparel."

Another surveillance system specific to sports injuries was the National Athletic Injury Reporting System (NAIRS). Congress' concern for the impact of athletic injuries led to the formation of NAIRS. This reporting system was designed for the collection

of injury data on high school and college varsity sports participants, upon which detailed information could be kept (National Center for Educational Statistics, 1979).

According to Damron (1981), reporting systems for surveillance of sports accidents "leaves much to be desired." These systems focus on "after the incident events" and injuries requiring medical attention. In youth sports, most injuries do not receive medical attention. One can only conjecture as to the affect of repeated microtraumas, as well as serious injuries, on the future activities of youth sport participants. A proactive approach to biomechanics research on injury mechanisms in youth sports is needed, especially in those sports in which relatively high incidence and severity of injury has been reported in the past. This type of biomechanical analysis requires relationships to be drawn between the kinetics of sport activity, the level and incidence of pain, and site and type of injuries. Two studies (Brown & Kimball,1983; Brown & Abani, in press) on a population of adolescent power lifters exemplify this approach. Studies of this type could provide rationale for 1) the modification of sport rules; 2) the design and use of sports equipment and personal protective supplies, devices, and clothing; 3) equating competition; and 4) age requirements.

Design of Sports Equipment

There are two types of sports equipment. Balls, bats, goals, targets, starting blocks, and the balance beam are examples of activity-related equipment. The second type of equipment is safety-related equipment. In general, both types of equipment affects those who participate in sport.

Activity-Related Equipment. The physical characteristics of equipment (size, shape, weight, texture, coefficient of restitution, etc.) have a direct bearing on how sports are played.

Equipment made for young athletes seems to be based on opposing views. One approach suggests the down sizing of adult sports equipment for young athletes; logically, this approach contends that children are physically smaller and weaker than adults and, therefore, equipment used in youth sports should be made smaller and lighter. On the other hand, use of full size adult equipment by children reflects the concept that, if young athletes are to learn sport like adults, they should use adult equipment. This dichotomy in approach to the design of equipment is exemplified in many sports. For example, basketballs, softballs, tennis racquets, and baseball bats are made smaller and lighter for youth sports, whereas the net height in tennis and badminton, baseballs, tennis balls, basketball rim diameter, and balance beam remain a standard size for all levels of sport. The sport of soccer provides evidence to this "mixed bag" approach within a single sport. Ball characteristics reflect the down sizing approach, whereas goals for youth soccer are usually full size. The use of a smaller and lighter ball for soccer allows the young soccer player to throw and kick it farther. However, accuracy of the kick and control in maneuvering the ball is likely to be decreased in the use of a small ball.

Research justification for the use of down sized or adult size equipment in youth sports is lacking. There is a need for cooperative research by experts in motor learning, motor control, sport, and biomechanics in order to determine interrelationships between the physical characteristics of sports equipment and the physical and motor characteristics of young athletes. The following questions should be addressed in each sport:

1. What influences do changes in the physical characteristics of sports equipment have on the kinematics and kinetics of performance of young athletes?

2. If young athletes use adult size equipment, will they ultimately perform better in a sport as adults?

3. How should the physical characteristics of sports equipment change with changes in physical and motor characteristics of young athletes in order to have the most positive influence on their learning and performance?

Safety-Related Equipment. There are several factors which need to be considered in the design of equipment for sport. According to Hoerner and Vinger (1981), these factors include: economic position of the buyer, fit, weight, restriction of motion, limitation of visual or auditory input, usefulness, comfort, durability and user acceptance of the product. In addition to these factors, the design of safety-related equipment needs to consider injury surveillance data, kinetic analysis of potential stress associated with sport participation, and human tolerance. The development of standards for face shields and guards for amateur hockey, as reported by Hulse (1981), is one example of the development of safety-related equipment which has considered these factors and has resulted in the elimination of eye damage with loss of sight in amateur hockey. Biomechanics research can make a contribution to the design of safety-related equipment which can ultimately reduce the risks of youth sport participation.

Mechanical Analysis of Youth Sports Skills

Knowledge about the mechanics of performance of sport skills in young athletes is important. In addition to research on injury mechanisms and equipment design, other research questions on the mechanics of performance, by sport and by skill within each sport, need to be addressed. These questions include:

1. What are the mechanics of performance of sport skills?

2. How do variations in factors such as age, sex, anthropometry, strength, and speed of movement affect the mechanics of performance of sports skills?

3. What influence do various teaching methods have upon the mechanics of performance of sport skills?

SUMMARY

The rapid and relatively recent growth of youth sports has resulted in a general lack of knowledge about the involvement of young athletes in sport. Biomechanics, as well as other disciplines, can make substantial contributions to the knowledge base in youth sports. Specifically, research on injury mechanisms, equipment design, and the mechanics of performance of sport skills are areas of study in which biomechanics has an important role to play.

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