PROFILING

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Profiling is one of the most common strategies for identifying contributors to skilled athletic performance. DeGaray et al. (1974), Hudson (1980), Kovaleski et al. (1980), Morris and Underwood (1973), Sapega et al. (1984), Vaccaro et al. (1979), and Wilkerson (1983) are only a few of the researchers who have identified profiles for athletes. The most comprehensive profile was developed from biomechanical and physiological data of swimmers. The respository of data is at the competitive swimming evaluation center in Belgium (Persyn et al, 1979). Grabiner (1986) has profiles on male gymnasts primarily on physical characteristics, whereas Hudson (1980) and Wilkerson (1983) have advocated the use of biomechanical data collected from actual sports performances. In these studies, success in the sport correlated well with some of the components in the profiles. Laboratory tests of fencers in the 28th NCAA fencing championships reported by Ketlinski and Pickens (1973) did not correlate well with the actual performance of the fencers in the competition. Subsequently, Sapega et al. (1984) reported at a symposium on profiling that they had had 80 % success in predicting members of the 1976 U. S. Olympic fencing team. The published research in the International Journal of Sports Biomechanics from the Los Angeles Olympic Games of 1984 can easily be adapted to construct profiles of the elite ethletes. Profiling studies of young athletes, however, are limited in the literature. Since children are not yet physically developed, and early habits are difficult to change, it is logical to consider profiling the young athlete. Problems occurring during one's youth often plague young athletes throughout their lifetimes. If problems are not recognized early in life, they may also prohibit young persons from pursuing a sports career or recreational sports participation. Thus, one of the most important populations to profile is the young athlete.

The purpose of this paper is to discuss the rationales for inclusion of physiological, biomechanical, and performance parameters while profiling young athletes. In accordance with this approach, profile data of a summer youth sports camp are presented.

MATERIALS AND METHODS

In the United States, there are numerous sports camps for youngsters. One can attend a sports camp in almost any sport in any part of the U.S. for persons of both sexes and all ages. These camps lend themselves to the advancement of physiological and biomechanical information. It is possible to test many children on many variables within the camp setting. For example, at the University of Illinois the campers are tested during the day of registration. In addition, there are other tests that are administered during the session in cooperation with a station-rotation system that the coaches organize.

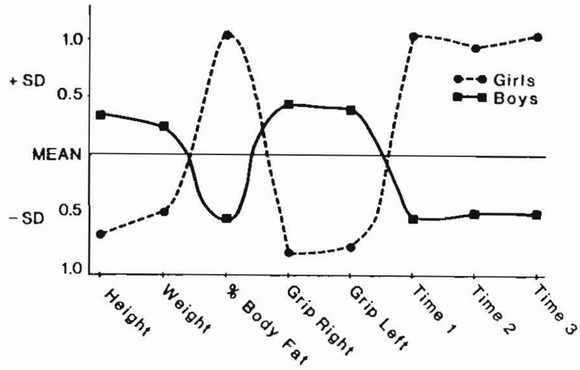

Figure 1. Comparison of profile curves for boys and girls in relation to the overall mean of height, weight, percent of body fat, right hand grip strength, left hand grip strength, time 1 (time to run the first 1.5 miles of a 3.0 mile run), time 2 (time to run the second 1.5 miles of a 3.0 mile run), and time 3 (time 1 + time 2).

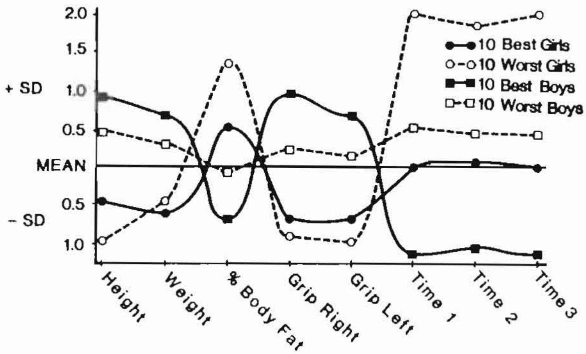

Figure 2. Same as in Figure 1, but 10 best and worst performers (boys and girls) in the 3.0 mile run.

Profiling is sports specific. Factors to be included in the profile of a youth cross-country population may not be the same factors included in the profile of a basketball performer. There will be some common parameters included in both sports, but there will also be unique parameters specific to each sport. For all sports, however, profiling can serve six purposes, (1) to determine the profile for a population sample, such as an elite athlete profile; (2) to compare individual profiles to the population profile; (3) to chart changes in individual profiles; (4) to identify causes of performance errors; (5) to identify causes of injury; and (6) to identify potential problems in performance and safety. Co-ed cross-country and girls basketball have been chosen as examples to explain the concept, process, and application of profiling.

The common parameters tested during the youth cross-country and the basketball sports camps included height, weight, triceps and sub-scapular skinfolds, right and left grip strength, right and left footprints, and standing posture. Additionally, the participants of the cross-country camp ran 3 miles as a running performance test. The parameters peculiar to the basketball campers included measurement of hand width, hand spread, and hand length, running alignment of legs and feet, basketball shooting, and explosive power as measured by a vertical jump from a force platform. The rationale

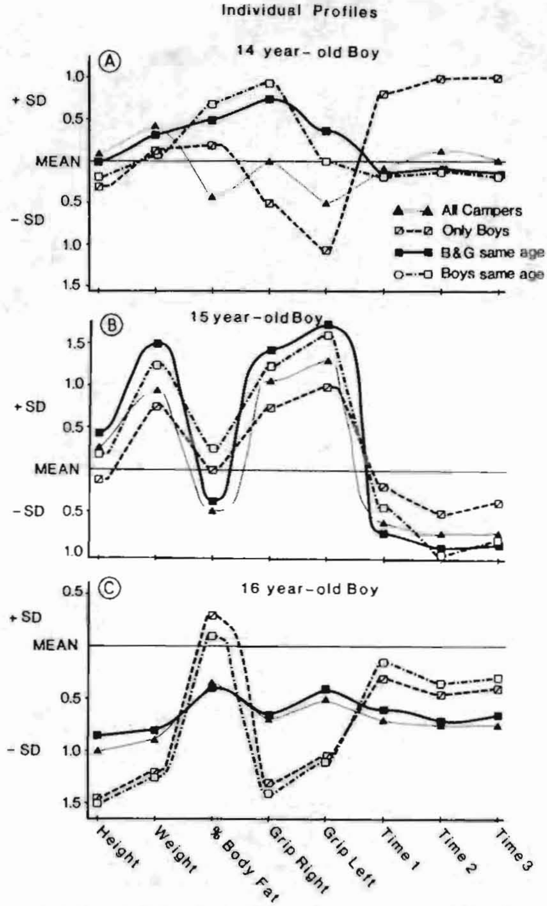

Figure 3. Individual profiles of (A) a boy 16 years of age, (B) a boy 15 years of age, and (C) a boy 16 years of age. The parameters are the same of Figure 1 and 2.

for the selection of these parameters is presented in the following paragraphs.

Height and weight are fundamental information. The sites for the skinfold measurements were the ones found in the regression equation to estimate body fat reported by Boileau et al. (1985). Thus, height, weight, and percent of body fat provide information concerning the shape and volume that must be moved during athletic performance. If the body is too fat, greater muscle effort is required to move the body. Therefore, for better performance in running the athlete should have a low percent of body fat. This information is also important for basketball players, since sprinting is required during the game of basketball.

The hand grip strength for both sports was measured to determine assymetry of strength. An assumption was made that the cross-country population would have more equal and lower strength in the hands than would the basketball players at that young age, since they were engaged in a sport in which the hands have a minimum role. Basketball players would, however, have one dominant hand at this early age of basketball playing. The more ambidexterous and skilled players should show greater symmetry and strength than all others. Thus, although hand grip was measured in both populations, the rationale for including the measurement was not identical. Likewise, this is true for the footprint data. Assymetry of feet will affect the ability to duplicate movements of the right leg with the left leg. In basketball, limited anomalies of one foot will predispose the youngster to move certain directions and avoid other movements in other directions. If there are only 3 toes on the pedograph (the footprint) this information can be used to suggest wider or longer shoes for the athlete and/or exercises for the feet. Lowered arches or excess arches also are of interest since the feet are a foundation of virtually all sports.

Specific to basketball were the measurements of hand spread and hand length. Hand size is irrelevant in cross-country runners. Thus, only for the basketball players, were hand dimensions of value.

Videotapes were obtained of standing posture as well as the sports specific movements. Identification of one shoulder higher than the other, severe signs of scoliosis, kyphosis and lordosis were determined from qualitative analysis of the videotapes. Any anomalies would affect performance.

Since jumping is an integral part of basketball, but not of cross-country, a jumping test was performed by the basketball athletes. A power program from the Advanced Mechanical Technology Incorporated (AMTI) computerized force platform system was used to record the weight and performance in the vertical jump from the force platform. A power curve, a work curve, and net force curve were obtained. It was evident, through video analysis, that at this young age the vertical jump is not a well-coordinated pattern among girls between the ages 12 and 16.

The cross-country runners were evaluated on their running performance from a side and a front view during a paced run. Leg alignment, trunk alignment, length of stride, position of feet, and trunk flexion were assessed. In addition, leg alignment, toeing in or out, length of stride, and general kinematics of movement were also assessed and included as values in developing the profile. Their times to run the 3 miles (TIME 3) as well as the split times to run the first mile (TIME 1) and the second mile (TIME 2) were recorded. In basketball, performance and consistency in shooting, and running were evaluated via videography. Qualitative assessments of biomechanically sound characteristics of performance were made.

Each individual was assigned a code number, and values for the different measured characteristics were written on the individual profile card. These data were then input into a database management system at the University of Illinois. The main computer, Cyber, was used. Using one of the statistical packages on the computer system (SAS) the means and standard deviations for each parameter were obtained for the whole population of each camp, for boys and girls separately, for the 10 best and 10 worst campers (according to their results in the performance tests) were obtained. The data reported here are only from the cross-country campers.

RESULTS AND DISCUSSION

The population mean served as base line for the comparison of the results to the mean of the parameters for boys and girls (Figure 1), to the mean of the parameters for the best and worst performers (boys and girls, Figure 2), and to the individual results (Figure 3A, B, C). Thus, the population profile is the horizontal line (x-axis) in the figures and the standard deviations above and below that line represent the standard deviation scores (y-axis).

It is evident from figure 1 that both the boys and girls subpopulation means vary with respect to the total population mean. Whether or not the deviation is a favorable deviation is dependent upon the variable. For example, the percent of body fat in the boys is more desirable than the percent of body fat depicted for the girls. Less fat allows the cross-country runner to perform at a faster speed for a longer period of time than would be possible with a greater percentage of body fat. However, the parameter height may be of little value except to provide information for the individual to compare him or herself to growth curves. The profiles of the boys and girls are almost a mirror image of each other. This is true for all components of the profile. Early separation of attributes at this age (12 to 16 years) is expected since the girls are likely to be post-pubescent and the boys pre-pubescent. Nevertheless, it was surprising to note the extent to which the means were so divergent.

Profiles of the best and worst performers (boys and girls) in the 3-mile run show the uniqueness of these subpopulations within the total cross-country group (Figure 2).

Individual profiles can be compared to population and subpopulation profiles. Such profiles can be considered comparison profiles. The individual profiles are seen to deviate from the mean of the total group (horizontal line). The individual data depicted in figure 3A comprise unique profiles deviating from all subgroups, whereas the individual profiles in figure 3C have common sex and sex-age profiles and different, but common, age and total group profiles. Figure 3B depicts another individual with common profiles with respect to all subgroups, but al these profiles deviate from the general population profile. Comparison profiles, therefore, are complex and difficult to interpret, since they can be depicted with respect to a variety of reference subgroups.

Another approach to the interpretation of profiles is to consider the individual profiles as baseline profiles, i.e., the initial characteristic of the cross-country runner would be compared with data obtained on this same runner during subsequent months or years.

As more and more data are collected, it may be possible to determine which components of the profile are related to injury, to potential problems in technique, to a predisposition to injury, or to skill in performance.

Profiling can provide the tool for coaches to individualize interaction with their athletes and also allow the athletes to obtain a more complete understanding of his or her characteristics. Profiles, however, should not be taken to mean that there is an ideal profile and those without the ideal profile or elite profile will not be able to perform. The profiles are an aid to the better understanding of young athletes. A pooling of profiling data and database throughout the world among all the sports will be essential in the future if we are to maximize the attainment of athletic performance among all athletes.

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