MULTIDIMENSIONAL EVALUATION OF YOUNG HANDBALL PLAYERS: DISCRIMINANT ANALYSIS APPLIED TO TALENT SELECTION

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The aim of this investigation was to analyse different anthropometrical, physical fitness and training characteristics of young handball players of different categories from a multidimensional perspective, in order to obtain statistically developed reference norms for various testing procedures, and to build multivariate models that could predict performance level at different age periods. 105 handball players with ages between 13-18 years old participated in the study, wich was made choosing the best players of the Galician Handball Federation (Spain). They were grouped into three official categories: 13-14 (U 14´s), 15-16 (U 16´s), and 17-18 (U 18´s). The multidimensional evaluation procedures included: 1) a specific questionnaire to analyse their sport participation background and training status; 2) a complete anthropometrical evaluation, including body composition analysis, somatotyping, and sexual maturation rating; 3) the Eurofit test battery (Council of Europe 1988) to measure general physical fitness; and 4) a vertical jump test battery (SJ, CMJ, and Abalakov). Different multivariate models were developed using discriminant analysis techniques (stepwise selection) to discriminate between players who were selected or not to play. The predictive capacity of the multivariate models developed by discriminant analysis , concluded that more of the 95% of players were accepted when all variables were included. The variables entering the multivariate models with highest predictive value were predominantly those derived from physical fitness and anthropometrical tests. Training levels appeared only at the oldest category group. From these results, we conclude that the best age for talent detection based on this type of multidisciplinary evaluation (sports background and training status questionnaire, anthropometry, and physical fitness comprehensive testing) seems to be 15-16 years of age (U 16´s category).

Introduction

It is generally accepted that objective talent selection in sports should take into consideration, the analysis of several individual factors relevant to performance, including the anthropometrical, physical fitness and training characteristics of young players. A multidimensional approach based on multivariate analysis has been successfully used to predict performance levels at different age periods in tennis,wich is an individual sport (Solanellas & Rodríguez 1996; Saavedra, Escalante, & Rodriguez, 2010), and collective sports (Burr et al., 2008; Coelho et al., 2010; Elferink-Gemser, Visscher, Lemmink, & Mulder, 2004, 2007; Falk, Lidor, Lander, & Lang, 2004; Gabbett, Georgieff, & Domrow, 2007; Reilly, Williams, Nevill, & Franks, 2000; Lidor et al., 2005; Mohamed et al., 2009; Vila, 2002).

The aim of this investigation was to analyse different anthropometrical, physical fitness and training characteristics of young handball players of different age categories from a multidimensional perspective, in order to obtain statistically developed reference norms for various testing procedures, and to build multivariate models that could successfully predict performance levels at different age periods.

Methods

Subjects

A total of 105 masculine handball players with ages between 13-18 years old participated in the study, wich was made choosing the best players of the Galician Handball Federation (Spain). They were grouped into three official categories: 13-14 (U 14´s), 15-16 (U 16´s), and 17-18 (U 18´s).

The study was approved by the Bioethics Committee of the University of A Coruña (Spain). The parents or legal tutors, of these players have signed an informed written consent previously to their participation.

Assessment Procedures

All subjects undertook a comprehensive battery of tests, which included assessment in the following domains: (a) sports background and training status, (b) anthropometry, (c) general fitness tests, (d) specific fitness tests, and (e) multidimensional evaluation. In concordance with the aims of the study (i.e., to develop multivariate models explaining handball players performance from a multidimensional perspective), a considerable number of assessments were included as predictive variables to ensure comprehensive evaluation.

Sports Background and Training Status

This domain was assessed by an *ad hoc* questionnaire including 16 items: 5 related to social background, 5 on sports practice, and 6 items on handball training and competition. This questionnaire assessed the relationship between handball player's performance and variables such as previous sports, handball practice, and number of weekly training sessions.

Anthropometry

Anthropometric measurements were taken according to standardized procedures (Ross and Marfell-Jones, 1982) by an ISAK (International Society for the Advancement of Kinanthropometry) certified anthropometrist. Measures include body dimensions (height, sitting height, arm span, and weight), lengths and widths (hand and foot), skin folds (triceps, subescapular, biceps, supraspinale, abdominal, front thigh, and medial calf), breadths (biacromial, biiliac, bitrochanteric, knee, elbow, and wrist), girths (chest, arm flexed, gluteal, thigh, and leg).

Body composition was assessed using a two-compartment model (Malina y Bouchard, 1991). Sum of six skin folds was used as main adiposity index. Somatotype was determined using the anthropometric method (Carter y Heath, 1990), and the three components (endomorphy, mesomorphy, and ectomorphy) were analyzed separately. Sexual maturation was assessed from the development of secondary sex characteristics according to Tanner (1962).

General Fitness Tests

General fitness was assessed using the Eurofit test battery (Council of Europe, 1998): shuttle run test assessed general aerobic endurance, flamingo balance assessed general

balance, plate tapping assessed segment velocity of the upper limbs, sit and reach assessed flexibility of the body and lower limbs, horizontal jump assessed explosive strength of the lower limbs, hand dynamometry assessed grip, abdominals in 30 s assessed body power, flexed arm hang assessed muscular resistance of the arms and shoulders, and shuttle run test 10 × 5 m assessed agility-velocity.

Specific fitness tests

Each subject performed three kinds of maximal jumps on a Jump Mat (Ergo Jump Bosco System ®, Byomedics, SCP, Barcelona, Spain). The squat jump (SJ), starting with knees bent at 90° and without previous counter movement. The counter movement jump (CMJ), starting from a standing position allowing for counter movement, with the intention of reaching knee bending angles of around 90° just before jump. The subjects kept their hands on their hips throughout the jumps, in order to avoid the possible contribution of the arms to the jump. The Avalakof jump is a variation of the vertical jump test, used for measuring leg power. In this test, arm swinging is allowed to assist, generating maximum height. Subjects completed three attempts of each type of jump and the best one (in terms of flight time) was used for the subsequent statistical analysis. For motivational purposes, players were immediately informed of their performance. Between jumps, subjects were allowed to recover for three minutes to avoid fatigue. Jump height was calculated with the flight time.

Multidimensional Evaluation

Combined analysis of variables from the different domains (sports background and training status, anthropometry, general fitness tests and specific fitness tests) was made by developing multivariate models (see Statistical analysis for details).

Statistical Analysis

Unless specified, data are expressed as means ± *SD* (*SD*). The normality and equal variance of the distributions were tested using the Kolmogorov-Smirnov and the Levene tests, respectively.

In discriminant analysis (DA), subjects were classified by the sample-splitting method in four groups according to their performance level (selected and not selected) using a stepwise selection procedure. The criterion used to determine whether a variable entered the model (i.e., discriminant function) was Wilks's Lambda, which measures the deviations within each group with respect to the total deviations. The sample splitting method included initially the variable that most minimized the value of Wilks's Lambda, provided the value of F was greater than a certain critical value (i.e., F = 3.84 to enter). The next step was pair wise combination of the variables with one of them being the variable included in the first step. Successive steps were performed in the same way, always with the condition that the F-value corresponding to the Wilks's Lambda of the variable to select has to be greater than the before mentioned "entry" threshold. If this condition was not satisfied, the process was halted, and no further variables were selected in the process. Before including a new variable, an attempt was made to eliminate some of those already selected if the increase in the value of Wilks's Lambda was minimal, and the corresponding F-value was below a critical value (i.e., F = 2.71 to remove). Wilks's Lambda, canonical correlation index, and percentage of subjects correctly classified.