MULTIDIMENSIONAL EVALUATION OF HANDBALL PLAYERS: TALENT SELECTION BY DISCRIMINANT ANALYSIS

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Summary
The aim of this study was to analyse different anthropometrical, physical fitness and training characteristics of young female handball players of different age categories from a multidimensional perspective. The predictive capacity of multivariate models developed by discriminant analysis reached around of 90% of players correctly classified when all variables were included.

Keywords: *Evaluation multidimensional, Discriminant analysis, Talent.*

Introduction

Sports performance is the result of a complex process involving many factors. Performance capacity has been studied using a multidimensional assessment approach in different 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; Saavedra, Escalante, & Rodriguez, 2010). Nevertheless, in handball there are very few studies published (Fernández, Vila, & Rodríguez, 2004; Lidor et al., 2005; Mohamed et al., 2009). The performance is considered a discrete variable, usually categorized in two groups (i.e., selected/nonselected, elite/nonelite), discriminant analysis seems to be the preferred technique (Gabbett, Georgieff, & Domrow, 2007; Reilly et al, 2000; Fernández, Vila, & Rodríguez, 2004).

The aim of this investigation was to analyse different anthropometrical, physical fitness and training characteristics of young female handball players of different age categories from a multidimensional perspective.

Methods

Subjects

A total of 91 female handball players aged 13-18 years participated in the study, selected among the best players of the Galician Handball Federation (Spain). They were grouped into three official age categories: 13-14 (INF), 15-16 (CAD), and 17-18 (JUV). The study was approved by the Bioethics Committee of the University of A Coruña (Spain). The handball players' parents or legal tutors 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 accordance with the aims of the study (i.e., to develop multivariate models explaining handball playing 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 included body dimensions (height, sitting height, arm span, and weight), lengths and widths (hand and foot), skinfolds (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 skinfolds 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. The age of menarche was assessed by recall.

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 trunk and lower limbs, horizontal jump assessed explosive strength of the lower limbs, hand dynamometry assessed grip, abdominals in 30 s assessed trunk 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 in 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 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 pairwise 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 aforementioned "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.

Results and discussion

The results show high performance prediction level of the DA models in the three categories (92,3%, INF; 90%, CAD; and 85,7%, JUV) (Table 1). The results are in line with those obtained by Mohamed et al (2009). These values are lower than those reported in young handball players (Fernández, Vila, & Rodríguez, 2004).

Table 1. Predictive capacity of multivariate models (discriminant analysis) developed from the multidisciplinary evaluation of young female handball players (n= 91).

Multidimensional evaluation	**13-14 (INF)**	**15-16 (CAD)**	**17-18 (JUV)**
All discriminant functions and variables included			
Canonical correlation index	0.74	0.74	0.87
Correctly classifield (%)	92.3	90.0	85.7
First discriminant function included only			
Canonical correlation index	0.53	0.56	0.65
Correctly classifield (%)	70.0	68.8	58.6
Variables entered	Abalakov jump Team sport first played: sport team Standing long jump Training sessions/wk Trochanterion height Simultaneous sports Abdominals (1 min) Hand length Age at beginning of sports participation Horizontal jump	Standing long jump Hand dinamometry Mesomorphism Abalakov jum Shuttle run endurance	Biacromial breadth Training sessions/wk Sit & reach Abdominals in 1 min. Arms flexion Injuries Squat Jump Hand width

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Conclusions

Altogether, these results support the notion of the multidimensional nature of this sport. The best age for talent detection based on this type of multidisciplinary evaluation seems to be 15-16 years of age (CAD category), when coordinative and cognitive factors probably begin to play an increasingly important role in handball performance.

One practical implication may be deduced: power should be considered not only as capacities which guarantee long-term athletic development, but also as predictors of performance itself.

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