Anthropometrical, physical and physiological predictors of performance in rhythmic gymnastics

Douda Helen, Avloniti Alexandra, Tokmakidis P. Savvas
Democritus University of Thrace, Department of Physical Education and Sports Science, GR-69100 Komotini

Introduction
Elite female athletes of Rhythmic Gymnastics (RG) ought to maintain specific physical abilities in this highly specialized discipline in order to achieve a successful performance (Douda et al., 2002; Hume et al., 1993). Although several studies have been published describing various aspects on Rhythmic Gymnastics (Douda et al., 2002; Guidetti et al., 2002; Hutchinson et al., 1998) few studies have examined the anthropometric, physical fitness and physiological factors, which have contributed to the success of young RG athletes (Alexander, 1989; Hume et al., 1993). Despite the above studies, there is some conflict concerning the anthropometric, physical and physiological factors, which are important in order to determine the performance of rhythmic gymnasts. The aim of the present study was to identify the predictors of Rhythmic Gymnastics (RG) performance, which was defined from the total ranking of each athlete in the national competitions.

Methods
Thirty-four rhythmic gymnasts (n=34) were divided into two groups, elite (n=15) and non-elite (n=19), and underwent a battery of anthropometric (height, body mass, armspan, diameters, circumferences, skinfolds), physical fitness (hip and shoulder flexibility, leg lift forward and sideward, 30m sprint test, explosive power, jumping ability) and physiological measurements (VO2, HR, VE, RER, La). These variables were combined into six components using a principal components analysis (PCA) procedure. A multiple regression analysis was used to determine which components best explain the variance in RG performance.

Results
The PCA extracted six components (anthropometric, flexibility, explosive strength, aerobic capacity, body dimensions, anaerobic metabolism). Based on the multiple regression analysis, the anthropometric component explained 45% of the total variance in RG performance, flexibility 12.1%, explosive power 9.2%, aerobic capacity 7.5%, body dimensions 6.8% and anaerobic metabolism 4.6%. Components of anthropometric (r=0.50) and aerobic capacity (r=0.49) were significantly correlated with performance (p<0.01). In addition, when applying a multiple regression model to elite athletes (y = -10.708 + 0.0005121*VO2max + 0.157*armspan + 0.814*midthigh circumference - 0.293*body mass) 92.5% of the variation was explained by VO2max (58.9%), armspan (12%), midthigh circumference (13.1%) and body mass (8.5%).

Discussion
The results of the present study revealed that anthropometric characteristics, flexibility, explosive strength, aerobic capacity, body dimensions and anaerobic metabolism are important factors and lead to a better execution of rhythmic gymnastic routines. The anthropometric component has the largest amount of cumulative variance in the PCA model. Indeed, the appearance and the aesthetic standards of body shape in rhythmic gymnasts entail a better execution of gymnastic movements, which may also be more pleasing to the judges. In reality, competitive routines last about 60 to 90 seconds in length, with each type of apparatus (rope, hoop, ball, clubs, ribbon), and usually combine elements, which require high intensity effort with a dexterous manipulation of the apparatus. Based on the results of the PCA, among the physical measurements, flexibility and jumping ability have been considered good determinants of performance, because routines are partly judged on the range of motion exhibited by the gymnasts in a variety of movements and explosive jumps. The multiple regression analysis showed that the absolute value of VO2max was the first predictor of attainment and was highly correlated with performance of elite athletes. The significant correlation of the above determinants with performance supports the need to include such criteria in talent detection that emphasize certain anthropometric characteristics as well as the VO2max, which was identified as the first predictor of performance in elite RG athletes. Thus, coaches should be aware of these specific attributes in order to improve talent identification and training of rhythmic gymnasts.

References